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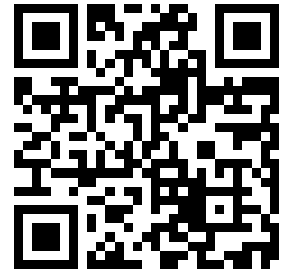

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# *General Electric Company Review*

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March — October, 1903

*General Electric Company*
*Schenectady, N. Y.*

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# GENERAL ELECTRIC COMPANY REVIEW

Vol. 1. Schenectady, N. Y., March 2, 1903. No. 1.


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## THE GENERAL ELECTRIC COMPANY REVIEW.

The Sales Committee instructed the Publication Bureau to prepare and issue this periodical for the exclusive information and assistance of the Company's agents. Correspondents have been appointed in the various local offices and departments, and doubtless before another issue, a system for collecting and publishing interesting facts, information and descriptions will be perfected The co-operation of all in the effort to make the Review interesting and useful is earnestly solicited, and suggestions as to the contents or arrangement will be welcomed. Reference to important installations or large contracts secured will influence prospective customers, and a knowledge of the success of new applications of electricity means a new field for the sale of electrical appliances. An examination of this first number will doubtless suggest desirable data for following issues.

Information for the Review may be handed to the local correspondent or forwarded direct to the Publication Bureau.

## TYPE M CONTROL.

### Peculiar Accident on High Speed Road.

A peculiar accident happened the other night on the road of the Columbus, Buckeye Lake & Newark Traction Company to a motor car going west from Newark toward Columbus, about 9.30 o'clock. Some malicious person had tied a rope to a large stone and thrown the other end of the rope up over the trolley wire. As the car was going at a rate of about 25 miles an hour, the stone went through the front window, striking the motorman on the head and knocking him off the stool. The cars are equipped with the General Electric multiple controller, and it is necessary at all times for the motorman to hold down the spring on the handle. As soon as his hand was removed from this spring the power was cut off; consequently the car stopped. The conductor, after giving two bells to proceed and receiving no response, went through the car to the front end and found the motorman lying unconscious in the vestibule.

J. R. Harrigan, the general manager of the company, says that but for this precautionary device the car would have probably run off the track at the approaching curve, and might possibly have run into the canal.—*Street Railway Journal, Nov. 8, 1902, page 798.*

## ENCLOSED FUSES.

Open fuses are being gradually superseded by enclosed fuses which are becoming very popular. This is largely owing to the ruling of the Underwriters that enclosed fuses shall be used except in positions where the melting of an open fuse would do no

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harm; that is, in fireproof cabinets, etc. To meet the increasing demand for a fuse of this kind, we have prepared a complete line of cut-outs taking enclosed fuses.

The cut-outs for 220 volt distribution circuits include the double- and triple-pole main line, double- and triple-pole single-branch and double-pole double-branch cut-outs. These cut-outs are for a maximum current of 30 amperes. For larger currents and higher voltages, the single-pole cut-out has been adopted as the standard.

The cut-outs for 250 and 500 volts, up to 100 amperes, are listed on page 11 of Fuse Block Catalogue No. 7569, and their respective enclosed fuses are listed on pages 13 and 14 of Fuse Catalogue No. 7564. Since the issue of the above catalogues, we have increased our line to include 250 and 500 volt single-pole cut-outs taking enclosed fuses, up to a maximum of 400 amperes capacity.

During 1902, we received orders for 26,406 220 volt enclosed fuse cut-outs and 92,945 220 volt enclosed fuses of various capacities, and the demand is continually increasing.

The Underwriters have recently approved in Electrical Report No. 1069, cartridge fuses and bases for 30 amperes, 250 volts. These fuses are covered by Cat. Nos. 9551-2, 3 and 4.

In Report No. 1333, they have also approved 60 ampere, 250 volt Edison plug fuse bases, Cat. Nos. 10975-6, 7 and 8, and plug for the same, Cat Nos. 10979 to 84 inclusive.

The 30 ampere, 125 and 250 volt Edison fuse plugs have previously been approved in the Underwriters' Code. The all porcelain screw plugs are approved for 125 volts and less. For 250 volt work a special type of fuse plug, Cat. No. 23980, to be used with enclosed fuses, Cat. Nos. 23955 to 23962 inclusive, has also been approved.

## INSTRUMENTS.

Our instrument business has increased materially over last year, and the fiscal year of 1902 is the largest in the history of our instrument business. There are to-day not less than 50,000 high grade General Electric instruments in use. Both our Horizontal Edgewise Instruments and our Astatic D.C. Instruments are now firmly established, and it is interesting to note that they are most commonly specified by consulting engineers in connection with switchboards. These gratifying results have been secured by the careful work of our engineering and commercial departments.

Our instruments are being largely used by colleges and educational establishments generally. Business of such institutions should be vigorously sought as being specially advantageous to us. Attention is called to the fact that such institutions are entitled to a special discount. Very recently we have closed an order for over $1400 worth of instruments for the laboratory of the Rensselaer Polytechnic Institute.

We are convinced that more business can be secured from contractors and builders of small switchboards. This business should be cultivated. We are well equipped with lines of instruments to suit the requirements of this class of trade. One extremely large independent switchboard manufacturer uses substantially nothing but General Electric Company instruments in all of his projects.

Every central station in the United States should have an equipment of portable instruments. Relatively few stations have such an equipment. This business has only to be sought to be secured. The sale of one portable instrument per annum to every central station in the United States would amount to a total business of from $75,000 to $100,000 per annum. We should bear this neglected field constantly in mind. It is important to read and thoroughly master the contents of Instrument Pamphlet No. 1033.

## MERIDIAN LAMPS.

Bulletin 4314 on Meridian Lamps is now ready for distribution.

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## RECENT CONTRACTS CLOSED BY THE GENERAL ELECTRIC COMPANY.

East St. Louis and Suburban Ry.

1–300 Kw. Monocyclic Generator.

Three-phase Alternator driven by D. C. motors.

Switchboard and Transformers.

Potomac Electric Power Co., Washington, D. C.

3–500 Kw., Six-phase, 225–300 Rotary Converters.

1–600 Kw., Six-phase, 575 volt Rotary Converter.

Detroit (Mich.) Edison Co.

4–3000 Kw., 60 cycle Turbine Sets.

Schenectady (N. Y.) Street Railway.

3–500 Kw., Motor-generator Sets for changing 25 cycles to 60 cycles. Motors are wound for 10,000 volts.

Los Angeles (Cal.) Edison Co.

1–2000 Kw., 50 cycle Turbine Set.

New York Central & H. R. R. R. Co., New York City.

2–400 Kw., 60 cycle Alternators, Exciters, etc.

Somerville (Mass.) Electric Light Co.

1–1000 Kw., 60 cycle Alternator.

Queensborough (N.Y.) Gas & Electric Co.

1–1500 Kw., 60 cycle, quarter-phase Turbine Set.

New York State Reformatory, Elmira, N. Y.

3–125 volt, D. C. Generators, Engines and Switchboard.

C. S. Knowles, Boston, Mass.

12–30″ Projectors.

4–Ardois Signal Sets.

Missouri Edison Co., St. Louis, Mo.

1–1500 Kw., Monocyclic Generator.

St. Joseph (Mo.) Railway Light and Power Co.

2–425 Kw., 60 cycle Generators driven by D. C. motors.

Georgia Railway and Electric Co, Atlanta, Ga.

2–400 Kw, 60 cycle, quarter-phase Rotary Converters and Transformers (Duplicate order).

Zanesville (Ohio) Railway, Light and Power Co.

2–500 Kw., 60 cycle Turbine Sets.

## BOSTON OFFICE STORE ROOM.

The store room of the Boston Office has recently been moved from the rear of the present office building, No. 200 Summer Street, to a modern structure numbered 77 and 79 Washington Street (North). The new store room occupies the fourth and fifth floors of the building, a floor space of 11,000 square feet. The location, moreover, is very desirable, being near the freight terminal of the Boston & Maine Railroad.

## POWER APPLICATIONS.

### Constitution Publishing Co., Atlanta, Ga.

One of our most novel installations consists of two printing press equipments which we are putting in for the Constitution Publishing Company, of Atlanta, Ga. These equipments are direct connected to two Hoe double presses, and consist: one of a 35 H.P., slow speed, 220 volt, direct current motor, with 7½ H.P. starting motor and gearing, for one press, and a similar equipment for the second press; using a 25 H.P. instead of a 35 H.P., main motor. Type M control is used, with the master controllers placed at the side of the mechanical control for the presses. The motors and gearing are placed in pits, and contactors, rheostats, and switchboards supported on the wall of the press room above the pits. The 7½ H.P. motors are used for both starting and slow motion, power being transmitted through worm gearing so that speed variation of from zero to 10 revolutions per minute of the press shaft can be secured. The 7½ H.P. motors are compound wound, and the speed control is, of course, obtained entirely by armature resistance. The MP motors, which are shunt

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wound, are connected to extensions of the press shafts by spur gearing. Speed control up to 160 revolutions per minute of the press shaft is secured by resistance in the armature circuit, and from 160 to 200 revolutions per minute by variation of field strength.

A novel device is used in the worm gearing. The worm wheels are made in three sections, a central disk keyed to the shaft and two outside disks running free on the shaft and uniting to support the bronze rim of the worm wheel in which the teeth are cut. The center disk carries 8 toothed pawls, held in place against a steel ring by spiral springs. These pawls engage with the ring when power is transmitted from the 7½ H.P. CE motor through the worm gearing to the extension of the main press shaft. When the MP motor is started and power supplied directly to this shaft through the spur gearing, the inner disk of the worm gearing which carries the pawls runs away from the worm wheel itself. At this point current is cut off from the CE motor, which consequently stops. One of these equipments has been in service for something over six weeks and has given excellent satisfaction. The second equipment will probably go into service the latter part of this month.

The principal advantages of the system are perfect steadiness of driving power, absolute control of speed, large saving of floor space, and economy of operation. There is, of course, the usual push-button circuit around the press, so that power may be cut off from any desired point as well as at the controller. The hand brake is retained on each press, and the original mechanical drive has not been interfered with. It will, therefore, be possible in this case to drive either press electrically or mechanically. Furthermore, by slipping the gear on either press, each press may be driven from its own or the other electrical equipment.

With these safeguards, a shut-down of either of the presses for more than a few minutes is practically out of the question.

**City of Boston — North Ferry.**

We are installing for the City of Boston, at the North Ferry, two I 12-20-600, 550 volt, Form M Induction Motors, operating gypseys, which are used to help heavily loaded teams up the incline from the ferryboats to the slips. The City Engineer has also on trial a GE-800 motor, with appurtenances, at the Charlestown drawbridge. Through double reduction gearing this motor operates winchheads by which vessels are hauled through the draw at a speed much greater than has before been possible. This is of great value in reducing the hold-up of the schedule of the Boston Elevated R. R, which crosses the bridge, and the City Engineer will probably install several such outfits, on various bridges, if the necessary appropriation can be obtained.

**Boston Globe Newspaper Co., Boston, Mass.**

The Boston Globe Newspaper Co. has recently purchased from us, five additional Linotype motors making a total of thirty-nine in their plant. This is the largest number of G. E. Linotype motors in any one plant, the largest electrically operated battery of linotypes in New England, and one of the largest in the country.

**Charlestown Navy Yard.**

At the Charlestown Navy Yard, we are installing in the Chain and Anchor shops, four 40 cycle motors of various sizes. One of these, an I 12-100-400, 550 volt, Form M, is to drive, through double reduction gearing, a pair of 18″ rolls, and by belt, a pair of 10″ rolls. A 26 ton fly wheel is used on the 18″ rolls.

The installation includes, besides this motor, two 20 H.P. machines One, a Form L, is belted to a countershaft from which a pair of alligator shears and a coke grinder are belted. The other is geared to bar shears and is Form K. The fourth motor is 15 H.P. and is to operate a testing machine.

**Concord Mfg. Co., Penacook, N. H.**

The Concord Mfg. Co. of Penacook, N. H., has recently changed to the electric drive

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and has purchased an ATB 12-150-600, 600 volt belted generator and a number of 550 volt motors in sizes from 5 to 50 horse-power.

**Union Bag and Paper Co., Sandy Hill, N. Y.**

An example of parallel operation, at a distance, of water-wheel and engine-driven generators, is at the plant of the Union Bag and Paper Co., Sandy Hill, N. Y., where there is, moreover, one of the largest three-phase transformers yet installed.

At this plant, two ATB 48-750-100, 6600 volt water-wheel driven generators are located in the bag mill, operating 550 volt motors in that mill and delivering current to the sulphite mill, on the other side of the river, about half a mile away. At the receiving end, the current is stepped-down to 575 volts through a 1100 Kw., three-phase, air blast transformer and is used in parallel with an ATB 40-1000-120, 600 volt engine-driven generator. The motor equipment of the two mills consists of thirty belted machines in sizes from 5 to 200 horse-power.

**Springfield Printing & Binding Co., Springfield, Mass.**

The Springfield Printing & Binding Co. has just awarded the G. E. Co. the contract for equipping twelve large cylinder presses with motors, together with the generator and switchboard. This will be the largest electrically operated printing plant in New England.

**Susquehanna Silk Mills, Sunbury, Pa., and Marion, Ohio.**

The above company has had in operation for several years at Sunbury, Pa, a mechanically driven silk mill, operating weaving, warping and winding machinery and quite successfully. When, however, the question of a new mill came up, it was decided after duly considering the matter, to adopt the electric drive, equipping each individual machine with a small motor.

The reasons for its adoptions were:

(1) The doing away with all long lines of overhead shafting and long vertical and quarter-turn belts and, therefore,

(2) The absence of dust in the woven fabric. This dust was carried by the vertical belts and settled on the fabric as it was woven.

(3) The saving in cloth which had to be classed as seconds, amounting to quite a large percentage of the cloth made.

(4) The saving in labor of inspecting the cloth.

(5) The facility of operation offered by the new system.

(6) The steadier speed to be obtained due to the fact that each piece of machinery with its motor became a self-contained unit, and therefore did not have the same effect as a number of looms which were attached to the same countershaft, some of which were stopping and starting continually.

(7) As a result of the steady speed the product is expected to be better and the output larger.

(8) The saving in repairs to looms and therefore a decrease in the amount of labor employed for this purpose.

The main reasons at the present time are shown in Nos. 1, 2 and 8, which have already been demonstrated.

(9) The fact that in Europe this method has has been in vogue for some years with successful results.

The first installation consists of:

One alternating three-phase revolving field 40 cycle generator, 230 volts, 250 Kw., driven by standard Harrisburg engine. The shaft of the generator is extended and the exciter is mounted directly on this shaft extension furnishing direct current at 125 volts to the generator field.

The motors are all three-phase, 40 cycles, 220 volts, induction type, and are specially arranged for direct connection to each machine by means of a short belt.

Two hundred and eighty-six (286) are being supplied to complete the first installation. These motors are $\frac{1}{3}$ and $\frac{1}{2}$ H P.

The motors are located on the floor, close to the looms, and drive up to the loom by a

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short belt, current being taken from mains running under the floor.

The motor is spring-supported in a cradle so as to keep the belt tight and further to take up the shock from the loom when starting and stopping.

A controller operated from the ordinary operating handles on the loom controls the motor, which may be started, stopped and reversed without any more care or attention from the operator than necessary in the mechanical drive and where tight and loose pulleys are used.

On the warpers, the motors, $\frac{1}{3}$ H.P., are again located on the floor but inside the body of the machine, a short belt being used for the connection. A controller operates the motor, and is arranged to provide the necessary slow starting so the threads will not be broken.

A foot lever operates the controller; no change being made over the method of starting with the mechanical drive.

On the winders, a $\frac{1}{2}$ HP motor is spring-suspended and mounted on a bracket built into the machine, a short belt being again used for the connection. A triple-pole switch mounted in an iron box and fastened to the form of the winder, controls the current to the motor.

Each motor is protected by plug cut-outs concealed in the controller or switch-box, as the case may be, and easy of access.

The switchboard is a standard marble board with the necessary generator and feeder panels and arranged so the equipment may be extended.

The complete equipment of this plant will include about 500 motors.

## POWER TRANSMISSION.

### Edison Electric Co., Los Angeles, Cal.

The history of electrical interests in the West records many instances of pioneering, of bold and agressive engineering along new lines. Among the many progressive companies that have availed themselves of the unequalled facilities of the General Electric Company for the design and manufacture of electrical apparatus, is the Edison Electric Company, of Los Angeles. This Company is now bringing to completion its plant known as Mill Creek No. 3, which is the latest addition to its comprehensive system of generation, transmission and distribution of electrical energy.

This plant is noteworthy as having the highest head ever employed in a water-power plant. A brief description of it may be of interest.

The power-house is an extension of the building which accommodates the Company's Mill Creek No. 2 plant. Several miles up in the mountains the waters of the creek are diverted by a tunnel under the bed of the stream and by a connecting shaft, which collects the surface flow. This tunnel connects with a flume and sand-box from which the water is conducted a distance of about 5½ miles with a grade of .2 foot per 100 feet to the forebay. This conduit consists principally of concrete pipe and includes nineteen tunnels aggregating a length of 1.4 miles, and 5 inverted siphons, having a total length of .68 mile.

These siphons are provided with adequate air valves and blow-offs. The forebay has a capacity equivalent to about 6000 kilowatt-hours, from which extends the pressure pipe of about 1.6 mile with a fall of 1960 feet to the power-house. This pressure pipe line is constructed principally of 26″ and 24″ riveted steel of No. 14 to 0000 gauge.

When completed, the power-house will contain four 750 Kw., 430 R.P.M., 750 volt, 50 cycle, three-phase revolving field generators direct connected to Doble or Pelton water-wheels. There are also to be four 750 Kw., three-phase air blast transformers, which will raise the voltage from 750 to 33000-Y for transmission eighty-three miles to the City of Los Angeles.

This plant is part of a great system including four principal water-power plants and three principal steam plants, having a total generator capacity of about 11,000 Kw., approximately one-fourth of which is in the steam plants. Transformers are installed of a

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corresponding capacity, and fourteen substations are reached by the system, providing all classes of light and power service for a large number of towns and agricultural districts. Nearly all of the generator, switchboard, transformer, and motor apparatus of this comprehensive system is of the General Electric Company's manufacture, and it is exceedingly gratifying to note that troubles of any sort due to this apparatus are almost unheard of.

## ELECTRIC RAILWAYS.

The past year has witnessed a very rapid and widespread application of electricity to suburban and interurban roads, the installation being either an extension to a present city system or in many cases a new line connecting two cities or towns. The equipment of these systems has invariably called for A. C. apparatus, and the sale of such apparatus has been very large. There is also another and very important change being effected in many of our large cities that heretofore have used direct current apparatus entirely. Their lines and extensions are now increasing so fast and the amount of power used is so large that their systems are now being laid out with a central alternating power house and distributing power to rotary converter sub-stations. As an example of changes of this kind, the following are prominent:

Metropolitan Street Railway Co., Kansas City, Mo.

Twin City Rapid Transit Co., Minneapolis, Minn.

Philadelphia Rapid Transit Co., Philadelphia, Pa.

St. Louis Transit Co., St. Louis, Mo.

The following is a summary of some of the more important installations:

### Aurora, Elgin and Chicago Railway.

The attention of the entire engineering world has been attracted to the Aurora, Elgin and Chicago Railway. The one thing which has called so much attention to this road is *Speed.*

The maximum speed is 65 miles per hour with a schedule speed of 40 miles per hour, and with the numerous stops which the car is required to make, to maintain the schedule requires that a car shall be accelerated from standstill up to a speed of 50 miles per hour in 25 to 30 seconds. These requirements are more severe than any which have ever been met before in the history of the electric railway, and made the engineers of the Aurora, Elgin and Chicago Railway hesitate when it came to the selection of the equipment.

These severe requirements have been successfully met by equipping each car with four GE-66 motors and the General Electric Type M Control.

All of the electrical equipment for this, the fastest electric road in this country, was manufactured by the General Electric Company. There is included in this equipment:

12 500 kilowatt, 600 volt rotary converters.

36–185 Kw. air blast transformers.

3–15 Kw. air blast transformers.

9–550 Kw. air blast transformers.

14–Blower sets for cooling the transformers.

7–Switchboards.

12–75 Kw. reactive coils.

3–ATB 40–1500–75, 2300 volt generators.

28–GE–66 four-motor equipments, with Type M Control.

1–Motor-generator set, consisting of MP 10–300–375–125 volt direct connected to I 8–450–375, 2300 volt.

2–MP 8–160–230, 125 volt generators with switchboard and rheostats for the above.

The following information may be of interest.

Third-rail road (100 lb. third-rail).

Length of road from 52d St. Chicago to Aurora, 33 miles.

Total mileage, approximately 60.

21 miles double track.

Running time Aurora to Chicago, express 45 minutes.

One radical step in the electrical equip-

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ment of the road is the absence of low tension switches on the transmission line, and relying on a single oil switch to open a circuit of 26,000 volts. This was a startling proposition to many of the engineers in all parts of the country.

The Street Railway Review says: "The oil switch, which has made this feasible, is of the same general type as that made by the General Electric Company for the Manhattan Elevated power-house in New York." (See Street Railway Journal, Oct. 4, 1902. Page 566.) The switch referred to is the Type F, Form H, electrically operated switch.

**Baltimore & Ohio R. R. Co., Baltimore, Md.**

**(Locomotives.)**

The City of Baltimore passed an ordinance forbidding the use of steam locomotives after a certain specified date. To meet this requirement, it is necessary to use electric locomotives. The Railroad Company placed an order with the General Electric Company for two 150-ton locomotives. Each 150-ton unit is made up of two separate and complete 75 ton units, the two being operated together by means of train control Each 75 ton unit is equipped with four GE-65 (225 H.P.) motors. These machines are now being constructed and will be completed some time in June. These will be the most powerful (either electric or steam) locomotives ever constructed.

**The Boston & Worcester Street Railway, Mass.**

The Boston & Worcester Railway is a high speed interurban electric road just completed. Its main line extends from Brookline, a suburb of Boston, to the city limits of Worcester, a distance of 32 miles, part of which is over private right of way. Its cars will run from the center of Boston to the center of Worcester over the city tracks within the city limits which will be six miles in Boston and three miles in Worcester. There is also a branch line 8.7 miles in length to Hudson, and another one 20 miles long will be built within the next year which will require an additional sub-station located at Waltham.

All the electric apparatus for generator station, sub-stations and cars was manufactured by the General Electric Company.

**Equipment.**

1-1000 Kw., 25 cycle, 13200 volt engine-driven alternator.

1-500 Kw., ditto.

50-4-motor GE-57 equipments with K-14 controllers.

These controllers are to be later changed to the "M" control.

Average schedule speed, 21 M.P.H.

Maximum speed on a level, 35 M.P.H.

**Population Served.**

Worcester, 120,000.

Boston, 800,000.

Intermediate towns, 110,000.

Number of sub-stations, 4, including one in power house.

Average distance apart, 10 miles.

**Number and Rating of Converters per Sub-station.**

2-250 Kw, in three sub-stations.

2-400 Kw., in one sub-station.

**Right af Way.**

Ten miles private right of way.

Balance public high way.

There are several unique features in connection with the road. They propose to equip with the multiple control, start cars from the terminals and trains, with one motorman and drop off cars at various junction points where the necessary motormen will be waiting to take them to their destination on branch roads. Another departure is the proposed use of commutating switches, which will throw all four motors of an equipment in series when entering cities, thereby economically keeping the speed down to the limits prescribed by the city ordinances. We have just closed a contract with the company for two 2000 Kw. turbo-alternators.

**Manhattan Elevated Railway Co., New York.**

One of the most important orders received by the General Electric Company in recent years was that of the train control and motor equipment for the Manhattan Elevated Railway of New York.

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After making elaborate tests on motors which were especially designed for this work by all the large electrical companies in the United States, the GE-66 was adopted by the Manhattan Railway Company, and orders placed with the General Electric Company for 1676 motors. For the same output the motors of our competitors showed an increase of 100% in temperature rise over the GE-66.

The General Electric Type M control system was adopted by the Manhattan Company because there is no control system manufactured by any other company which can compete with it in any way. Orders were placed for 855 of these equipments at one time.

The Electrical World and Engineer says: "The train equipment of the Manhattan may be considered one of the most important pieces of engineering work of recent years, and reflects the highest credit on the engineers concerned." (See E. W. & E., Jan. 25, '02, page 153)

The Manhattan Company also ordered 838 of the General Electric CP-14 air compressors, which have given universal satisfaction.

The following is some information concerning the Manhattan Elevated Railway:

One hundred and ten miles of track.

Motor cars are 47 ft. overall, to seat 48 people.

Each motor car is equipped with two GE-66 motors mounted on one truck.

Maximum train consists of six cars, of which four are motor cars.

Current is taken from a 100 lb. third-rail.

The General Electric Company has furnished the following apparatus:

Complete switchboards for generating and sub-stations.

1676 GE-66 motors.

855 M control equipments.

838 CP-14 air compressor outfits.

*Results:* It is expected that the road will be completely equipped electrically by April, 1903. The result is being watched with a great deal of interest. Public accommodations have been greatly increased on account of better cars, better lights, longer trains and higher speeds.

Although only part of the system has been equipped, the operating expenses for the past year were 50.10% of the gross receipts as against 55.38% of the previous year. It is estimated that the operating expenses for the current year will be 46% of the gross earnings. This figure, if obtained, is so satisfactory that comment is unnecessary.

During 1902 the receipts per car-mile were 23.70 cents and the operating expenses 12.26 cents per car-mile. It is expected that an operating expense of 10 cents per car mile will eventually be obtained. It is significant that since the use of electricity the traffic has increased enormously.

### Massachusetts Construction Company, Boston, Mass.

The Massachusetts Construction Company's system extends from Portsmouth to Nashua, N. H., a total distance of 70 miles, taking about 4¾ hours to make the trip, at an average schedule speed of 15 miles per hour, with an interurban speed of 22 miles per hour. This system serves 26 towns having an aggregate population of 300,000, the largest being Lowell, Mass., with a population of 100,000. There are several branch lines, also an interurban road connecting Dover with Rochester, resulting in a total mileage for the system of 104 miles which is practically all single track.

Power is supplied to the entire system from one polyphase generating station located at Portsmouth, N. H., and the maximum distance power is transmitted is 42 miles. All generating and sub-station apparatus and motor equipments are furnished by the General Electric Company.

#### Equipment

2-1000 Kw., 13200 volt, engine-driven, three-phase generators.

1-2000 Kw, 13200 volt, engine-driven, three-phase generator.

Number of sub-stations, 8.

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Average distance apart of sub-stations, from 8 to 12 miles.

Number and capacity of converters per substation (two 300 Kw. in six sub-stations; one 250 Kw. in two sub-stations).

**Massachusetts Electric Companies, Boston, Mass.**

The Massachusetts Electric Companies is a large consolidation of railway properties in eastern Massachusetts. This company has recently placed several large orders with us, prominent of which is an order for ten 2000 Kw. 25 cycle turbine outfits. These generators are to be used in equipping three generating stations. These stations will replace 14 old direct current stations. The turbine sets will supply energy to 14 sub-stations in which are located step-down transformers, rotary converters, etc. The apparatus will consist of switchboards for three generating stations, also switchboard apparatus, step-down transformers, rotaries, etc., for the sub-stations. The order for rotaries includes:

15–750 Kw. rotaries,
6–500 Kw. rotaries,
12–300 Kw. rotaries,
9–200 Kw. rotaries,

having an aggregate capacity of 19,650 Kw. Energy is supplied to the various sub-stations at 13,200 volts. The step-down transformers are of the three-phase type. This is a very large property and when the above apparatus is completed will illustrate in a very striking manner the application of the idea of a central alternating current power-house distributing power to rotary converter sub-stations.

**North Eastern Railway Co., London, Eng.**

We have just received one of the most important contracts ever awarded by a steam railroad company. The above railway company recently placed with the General Electric Company an order for electrical apparatus to be used to electrically equip one of its branches running between Newcastle and Tynemouth, a distance of about 40 miles. This order is particularly interesting as it will mark the first attempt by a large steam railroad system in England to electrically operate a branch line, and its relative success will be watched with a great deal of interest. Several engineers of the N. E. Ry. Co. were in this country last summer inspecting American railway installations and after careful consideration the following apparatus was decided upon:

Fifty double motor GE-66 equipments with M control.

Fifty CP-14 (20 ft.) air compressor outfits.

Two four-motor GE-55 equipments with M control for locomotives. These locomotives are also equipped with air compressors (CP-14).

Schedule speed will be about 22 miles per hour.

**Rockford, Beloit and Janesville Electric Railroad.**

This railroad is an electric line 34 miles in length, connecting Rockford, Ill., with Janesville, Wis., passing through Beloit, Wis., and several small towns. That portion of the line between Rockford and Beloit was placed in operation in the summer of 1902, but the entire road has been running only since November, 1902. The results thus far have been most satisfactory.

This road possesses no novel electrical features, but in the general adaptability of its equipment for moderate interurban service, it is a well designed system. The electrical apparatus throughout is of General Electric manufacture of the latest type and our agents can refer to this road with confidence such customers as may be interested in an enterprise of this character.

The generating station, located at Beloit, is 19½ miles from the Rockford end of the line and 13½ miles from the Janesville end. The generating apparatus consists of two ATB 32-540-94, 370 volt generators, direct connected to engines two MP 6-35-305, 125 volt engine-driven exciters of the General Electric "marine" type; six OC 25-135-370, 13200 volt step-up transformers, with the usual switchboard apparatus, etc. This station also contains two TC 4-200-750, 600 volt rotary

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converters with reactive coils and switchboard, which take current directly from the bus-bars and feed the central portion of the line.

Two transmission lines are employed; one feeding a sub-station at Douglas on the Rockford end of the line, 12 miles from the generating station, the other feeding a sub-station on the Janesville end, 10 miles from the generating station. Each transmission line consists of three No. 4 B. & S. bare copper wires. Each sub-station contains two TC 4-200-750, 600 volt rotary converters; six H 25-75-13200, 370 volt step-down transformers; two 30 Kw. reactive coils; switchboard, etc.

The low potential distribution system consists of a double 2-0 trolley, reinforced for a considerable distance on either side of the three direct current feeding points by a 4-0 feeder cable. The road is single-tracked with 70 lb. "T" rails.

The rolling stock consists of eight double truck, interurban type, closed cars. Each car is equipped with four GE-57 motors, geared for a maximum speed of about 45 miles per hour and capable of making the round trip of 68 miles in three hours, including stops and layovers. Each car is provided with one K-14 controller and runs "single ended."

In maximum regular service, the cars will run on half-hour headway, requiring six in operation at one time, and the station units are of such capacity that one machine is able to handle this service, leaving the second unit in reserve.

The road was built by the Wisconsin Construction Company, of which Mr. H. H. Clough is General Manager and Mr. Geo. W. Knox, Engineer. The offices of the Company are at Beloit.

### The St. Louis Transit Company.

To meet the increased demands for car service at the World's Fair, next year, the St. Louis Transit Company has improved and enlarged its system of street railway.

In the new North Power House, this company has installed two 250 kilowatt General Electric railway generators, two 1200 kilowatt General Electric three-phase generators; and they also expect to move to this station two 800 kilowatt General Electric generators from one of the old power-houses. The excitation for the alternating current generators is furnished by two 50 kilowatt motor-generator sets, which were manufactured by the General Electric Company.

The main switchboard in this station is 67 feet 5 inches long, and consists of standard General Electric panels. There is an auxiliary switchboard, consisting of 8 standard feeder panels, together with a high tension line panel. The current from these alternating current generators is used for transmission to the sub-stations at different points along the line.

The sub-station equipment includes 4-600 kilowatt General Electric rotary converters, which are operated from 13-250 kilowatt General Electric air blast transformers. The sub-station switchboard is 37 feet 4 inches long, and comprises 2 three-phase line panels, 4 alternating current machine panels and 10 direct current, 1200 ampere feeder panels: all made by the General Electric Company.

The remaining electrical equipment ordered from the General Electric Company, by the St. Louis Transit Company, includes:

4-three-phase 600 kilowatt rotary converters,

15-six-phase 1000 kilowatt rotary converters,

13-air blast 250 kilowatt transformers,

11-air blast 1100 kilowatt transformers,

19-159 kilowatt reactive coils,

2-5000 kilowatt turbine-generator sets, each set consisting of one 5000 kilowatt, three-phase, 6600 volt generator, direct connected to a Curtis steam turbine, and

2-2000 kilowatt turbine-generator sets, each set consisting of a three-phase, 2000 kilowatt, 6600 volt generator, direct connected to a Curtis steam turbine.

## CENTRAL STATIONS.

**The Boston Edison Co.** is laying plans for a central station on its property on L St.,

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South Boston, which will have an ultimate capacity of 60,000 Kw. They have already placed an order for two 5000 Kw. turbo-alternators, 60 cycles, 6900 volts; the intention being to reach the outlying territory within fifteen miles of the city. The Edison Co. has secured control of the lighting plants at Dedham, Canton, Milton, Natick, Framingham, Somerville, Newton, Woburn and Watertown, and will ultimately do away with the equipment of these local stations, supplying current from its high tension mains. The location of the new station, on deep water of the harbor, the improved station design and the size of the units, will, it is expected, result in such economy of generation that current can be delivered to the above places more cheaply than it could be generated in the local stations, in spite of the losses in transmission.

**The Cambridge Electric Light Company** has just started their new 3-phase, 60 cycle plant on the Charles River, a model direct connected plant. It contains one 1500 Kw. and two 600 Kw. engine-driven alternators, from which all classes of service are to be operated, motor-generator sets being used where direct current is a necessity.

**The Fitchburg Gas and Electric Company** are now installing in the new addition to their station a 400 and a 600 Kw., 3-phase, 60 cycle, engine-driven alternator, from which they will operate all classes of service. They have just ordered nineteen 3-phase, 60 cycle motors to replace the 500 volt D.C. motors on their present power service.

**The City of Holyoke** has just completed negotiations for taking over the gas and electric plant owned by the Holyoke Water Power Co. The city has recently contracted for two 350 Kw., 60 cycle, 2300 volt water-wheel driven alternators as the beginning of a model plant. A new outfit of transformers and meters will be purchased and CC transformers replace the Schuyler arc machines which have been in operation for many years.

**The Lynn Gas & Electric Company** is experiencing a great increase in lighting business and is obliged to materially increase its station capacity to meet it. This company has just completed the erection of an 800 Kw. fly wheel alternator, direct connected to an Allis-Corliss engine. In addition they have ordered two 450 Kw. alternators of the same type to be driven by Allis-Corliss engines in the station and a 500 Kw., 60 cycle turbo-alternator. It is their intention to change the station from belt to direct driven.

**The Consolidated Lighting Company of Montpelier, Vt.,** has recently ordered an ATB 47-450-150, 12000 volt, engine-driven generator. This machine is to be installed at Montpelier and run in parallel with two 450 Kw., 13,000 volt, water-wheel driven generators located at a water power sixteen miles away, the three machines supplying current to Montpelier, to Waterbury, ten miles toward the water power, and to Barre, eight miles in the opposite direction.

**The Worcester Electric Light Company** has just completed the installation of a 1200 Kw., engine-driven, fly wheel alternator and will soon proceed with the erection of an 800 Kw. machine of the same type as that which is already delivered. It is the intention at Worcester to change everything from belted to direct connected type.

## SWITCHBOARD NOTES.

The switchboard business of the Company has experienced a heavy increase during the fiscal year just ended. Substantially all of the very important switchboards of the United States are now being built by the General Electric Co. The most important transaction of the year was the New York Rapid Transit switchboard, which will be the largest ever constructed in the world, both as regards power controlled and money involved. This contract was awarded to the General Electric Co. at a much higher price than the bid of our chief competitor, indicating that it was secured purely on the strength of the

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merit and reliability of our devices. Mr. L. B. Stillwell, Chief Engineer of the Rapid Transit Sub-way Construction Co., was largely responsible for the decision. The net price of the Rapid Transit switchboard alone exceeds half a million dollars. This amount covers the switchboard and auxiliaries for the control of eight 5000 Kw. generators and eight sub-stations. The contract also covers future orders for switchboards to control five additional generators and additional apparatus for the sub-stations. Deliveries are to be completed January, 1904.

The Rapid Transit switchboard constitutes the third of a group of the largest and most important switchboards in the world. All three of these switchboards have been secured by the General Electric Co., and all three of them are located in New York. They are respectively:

The Metropolitan St. Ry. Co.
The Manhattan Railway Co.
The Rapid Transit Sub-way Construction Company.

Prospective customers for very large switchboards for use in connection with transmission propositions should be referred, in case of doubt, to these three large corporations, who have bought under the guidance of the most skilled engineering talent in the country. In talking to customers, agents should lay stress on the fact that all of the devices used on these switchboards are General Electric devices.

The lines of standard switchboards recently introduced are proving highly satisfactory. Prices will be found to be competitive. Standard boards now constitute substantially 25% of our orders. A large proportion of our switchboard sales are now made independent of apparatus sales, showing that our switchboards are strongly preferred to all others. Deliveries have been materially shortened during the last three months. The factory is now producing from 100 to 125 panels per week. Further lines of standard panels are being rapidly prepared. Suggestions pertinent to standard lines are desired. A considerable part of the incipient competition in oil switches has disappeared, owing to the greater superiority of our devices.

Notable switchboard contracts of recent date are as follows:

Old Colony Street Railway Co., Mass.
Boston & Northern Street Railway Co.
North Jersey Light & Power Co.
Philadelphia Rapid Transit Co.
Port Huron Electric Light Co.
Rochester Gas & Electric Co.
Potomac Electric Light Co., Washington, D. C.

Requests for propositions are greatly on the increase. We are now averaging about four proposals per day, and during the past two months the average switchboard work estimated upon per week has amounted to about $50,000.

Increased activity in canvassing the sale of small standard switchboards among isolated plants, etc., is urged. The works are equipped to produce these standard panels in excess of the present demand. The business and support of architects and builders should be sought in connection with this class of boards.

Mr. Ramsey, Chief Engineer of the American Woolen Co., has had unusual and valuable experience in connection with the operation of K oil switches on our boards and his views and experience are of great value. Customers could consult him to advantage.

Mr. Spencer, Chief Engineer of the United Gas & Electric Co. of Philadelphia, has recently investigated our general switchboard practice with the greatest care. Customers might seek his opinion to their advantage and ours. Mr. H. G. Stott, Chief Engineer of the Manhattan Railway Co., can also be consulted to advantage.

We quote the following from a very recent letter from Mr. L. B. Stillwell: "Experience with your oil switches thus far has been so satisfactory that I believe it will be sufficient to use but one of these oil switches and it is not necessary to place two in series." This means that our switches can be relied upon to open the circuit under the most adverse conditions.

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## TYPE H TRANSFORMERS.

### Vacuum Drying and Compound Filling Process.

For the last four years the General Electric Company has been using in connection with its Type H Transformers a vacuum drying and compound filling process to which is due to a very considerable extent the remarkable reliability of these transformers.

The compound used is composed of asphaltum suitably combined with solvents to give it greater efficacy as an insulating medium and to secure the proper density at ordinary transformer temperatures. By this skillful combination the compound is rendered tough and elastic so that it is not liable to crack or deteriorate in any way.

The transformers are insulated in the usual manner with mica, paper, treated cambric and cotton cloth; and are then treated with the compound which permeates every interstice of the winding, thus rendering it thoroughly waterproof and preserving the insulation, preventing crawling of the layers one upon the other, and by cementing the whole winding into one solid mass, aiding greatly in the radiation of heat. All of these result in longer life for the transformer and thereby give lower cost for maintenance and security to life.

A pamphlet will be issued shortly, describing this process and giving in detail the benefits that accrue from its use. Sample sections of treated coils have been sent to the Supply Managers, and as soon as they can be prepared similar sections will be sent to the sub-offices.

It is expected that with the aid of these samples the agents will be enabled to explain to customers the great importance of this process in transformer manufacture.

### Turbines.

We shall, in a few months, be in a position to obtain a most interesting comparison of condensing equipment with steam turbines. Three companies, the United Gas & Electric Co., Dover, N. H.; The Nashua (N. H.) Light, Heat & Power Co.; and The Old Colony, Newport (R. I.) and Fall River Street Railway Company, have placed orders for 500 Kw., 60 cycle turbo-alternators. The Newport Co. will use Wheeler condensers; the Nashua Co., Worthington condensers; and the Dover Co., Alberger condensers. The Dover Co., moreover, has ordered Sterling boilers with superheaters for 200 deg. superheat. The two 500 Kw. turbo-alternators which they have ordered will be installed in a new station on the Cocheco River and will supplement the water-power station four miles away, the two being connected by tie-lines.

**The Massachusetts Electric Cos.** has, within the past few months, awarded to the G. E. Co., contracts aggregating $1,125,000, calling for ten ATB 4-2000-750, 13200 volt turbo-alternators and complete equipment for fourteen sub-stations.

## WATTMETERS.

The meter sales of the fiscal year of 1902 have exceeded those of 1901 by about 12%. Competition has been keener than in any previous year, but the great merit of our devices has enabled us to secure business in the face of competition without resorting to change of price. The meter of our largest competitor is now the most important factor in the field and is commonly sold at from $1.00 to $2.50 below our price. This competition can be uniformly met with success by resorting to a careful and detailed explanation of the merits of our high torque induction meter.

The Thomson High Torque Induction Meter did not go into production until the last week in August. Since this date, we have taken orders for about 12,000 meters of this type, showing that the merit of the device has immediately carried it beyond its competitors.

Recent triumphs of the high torque induction meter in the face of severe competition from active leading competitors quoting lower prices, are:

**The Denver Gas and Electric Co.** This Company formerly used the Diamond meter,

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purchased at a much lower figure than our high torque induction meter.

The Boston Electric Light circuits of the Edison Electric Illuminating Co., where the meter of our largest competitor was formerly used for meter purposes.

Other noteworthy successes in the face of severe competition have occurred recently at Springfield, Mass.; Duluth, Minn.; Consolidated Light Co., of Burlington, Vt.; and the Augusta Railway & Light Co., of Georgia.

Large induction meter purchases have been made by the following companies:

Washington Water Power Co., Spokane, Wash.

International Light & Power Co, El Paso, Tex.

New Omaha Electric Light Co.

Butte Light & Power Co.

Cleveland Electric Illuminating Co.

Cumberland Electric Light & Power Co., Nashville, etc.

The sales of T. R. W. meters have exceeded the sales of all previous years. The Edison Illuminating Companies throughout the country have purchased heavily.

Certain strictly alternating current systems continue to use the T. R. W. meter by preference in large numbers. We occupy the unique position of being able to furnish two radically different types of meters applicable to alternating current, each the best of its class.

It is important to read and thoroughly master Bulletins Nos. 4282 and 4298.

Every customer using multi-phase current should be reminded that the General Electric Company has manufactured for four years a high grade polyphase meter, accurate for the measurement of unbalanced or balanced circuits of any character on three and four-wire two-phase, three-wire three-phase, and monocyclic systems. This meter has a full load torque of eighty millimeter-grammes.

The importance of torque must never be forgotten, since meter accuracy is dependent upon it. Purchasers should be taught to specify the torque which meters must have to be acceptacle to them. No customer should be permitted to buy any meter without inquiring as to the torque.

The General Electric Company makes a device for testing the torque of meters. It can be applied to any motor-meter on the market. It is sold to central stations at a nominal price. One should be placed in every central station and its use encouraged. A bulletin will shortly be issued on this device. This device can be obtained by ordering "The General Electric Meter-Torque Testing Balance."

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# GENERAL ELECTRIC COMPANY REVIEW

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## CORRECTION

In the March issue of the GENERAL ELECTRIC COMPANY REVIEW, a statement was made to the effect that the General Electric Company had just received a contract for the electrical equipment of the North Eastern Railway Company, London, England. This is an error, as the contract was secured by the British Thomson-Houston Company, and the apparatus will be manufactured under the General Electric Company's patents.

## GENERAL ELECTRIC COMPANY REVIEW

The REVIEW is now established as one of the General Electric Company's confidential publications and will hereafter be issued monthly.

The March REVIEW, which was in the nature of an experimental issue, resulted in a number of valuable suggestions. It is hoped that the new form of the present issue will prove convenient and attractive. The arrangement of the contents has not been materially changed, but we hope in the future to secure more news from the various local offices and to present each month a leading article of special interest.

The REVIEW can be made an interesting and helpful publication, but its value will depend much upon the co-operation of its readers Items of interest may be forwarded to the Publication Bureau at any time.

## CHRISTENSEN ENGINEERING CO.

The Christensen Engineering Co. built the 275 Kw., 600 R. P. M., 60 cycle, 2500 volt, three-phase revolving field generator which is now operated by the Janesville Light and Power Co., Janesville, Wis., and they have recently sold the same company a 150 Kw. generator of the same type. This company also secured an order from the U. S. Glue Co., of Milwaukee, Wis., for a 500 Kw., 900 R. P. M, three-phase, 40 cycle engine-driven generator.

## CONTROL

### Interborough Rapid Transit Company, New York City

Since the last issue of the REVIEW, we have received from the above company the important contract for all of the control equipments required for 340 motor cars and 160 trail cars for operation upon the New York Underground Railway. The contract for the equipment of these cars was placed after the most exhaustive and impartial tests on both the motors and control equipments. The contract for the control equipment was awarded to the General Electric Company on account of the superiority of the Sprague-General Electric control system in the following considerations: 1st, safety to passengers and employees; 2d, reliability of service; 3d, comfort of passengers; 4th, economy of power; 5th, low cost of maintenance; 6th, simplicity.

The service contemplated by this road has not in many respects been approximated in any installations which have heretofore been made. The carrying capacity of the road is to be utilized to its fullest extent, necessitating high schedule speed with consequent rapid acceleration and short headway. The length of the run between stations is short, averaging 2030 ft. on the local service

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and 6996 ft. on the express service. It is proposed to operate for local service five car trains, consisting of three motor cars and two trail cars; and for the express service eight car trains, composed of five motor cars and three trail cars. The schedule speed will be 16.2 miles per hour and 25 miles per hour respectively.

The severity of the conditions obtaining on this road have necessitated the most careful consideration of the question of controlling these equipments, both from the standpoint of insuring the greatest degree of safety to the passengers and also of the reliability of the system in insuring operation of trains without interruption of service and maintaining the regular schedule.

A short description of some of the special features of the control equipment will be of interest. All of the equipments will be controlled with the Sprague-General Electric system, the standard arrangement used on the Manhattan Railway and other roads being modified to meet the special requirements of the Rapid Transit Company. Each motor car will be provided with two C-18 automatic master controllers located in platform cabs. The special feature of this controller is the provision for automatic acceleration of the equipment. The operating cylinder is driven by the control-handle through the medium of a spring, the handle normally being moved immediately upon starting to the full series or full parallel position. This winds up the spring and causes the operating cylinder to follow the movement of the handle until it reaches a corresponding position.

To prevent too rapid movement of the cylinder, a limiting friction device is introduced which allows the cylinder to reach the full parallel position in about three seconds. The rate of current input to the motors is regulated by a current relay on each equipment in series with one motor, which closes a local circuit and locks the master controller cylinder against further movement until the accelerating current has fallen sufficiently to release the master controller cylinder for the next notch.

The current relays on the several motor cars in the train are connected in multiple, making the notching up of the controller dependent upon the current input to each car. This prevents the slipping of the wheels on one car, affecting the acceleration of the train as a whole.

The controller can also be notched up by hand, providing the controller is not turned fast enough to exceed the predetermined accelerating current for which the current relay is set. In addition to the usual safety cut-off operated by releasing the knob in the controller handle, the controller is also arranged to apply the air brakes to the entire train if the safety cut-off knob is released.

The contactors for these equipments will be of the latest type, having several units mounted upon a common base. The contactors are enclosed in substantial sheet iron boxes lined with heavy asbestos and arranged for convenient inspection.

Another feature of these equipments is the use of an automatic circuit breaker on each car. These circuit breakers are of special construction quite similar to the contactors and arranged to be set and tripped electrically from the cab from which the train is being operated. This circuit breaker is provided with an efficient magnetic blow-out and a final break of copper upon a substantial carbon block to absolutely prevent welding.

The tripping coils of the circuit breakers are designed to be energized continuously. If the energizing circuit for these coils is interrupted either from the motorman's cab or in case of the train breaking in two, the circuit breakers are immediately opened. The circuit breaker is enclosed in a substantial sheet iron box and located underneath the car. The circuits for setting the circuit breakers are interlocked with the control circuit in such a way as to prevent setting the circuit breakers unless the master controller is in the off position. In addition to the circuit breaker, each car is provided with a magnetic blow-out copper ribbon fuse as an additional protection.

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The most careful attention has been paid to making these equipments absolutely fireproof. The entire bottom of the cars is sheathed with $\frac{1}{4}''$ asbestos compound. This sheathing is $\frac{1}{2}''$ in thickness above the contactor and reverser boxes. The contactor boxes are supported from iron brackets by means of insulated bolts, thus insuring a double insulation between the contactors and the car body. The wiring underneath the car is secured against the asbestos sheathing by means of asbestos compound cleats. Over the contactor boxes the wiring runs into the pocket formed by the top of the box frames and the asbestos sheathing on the bottom of the car. All of the control circuit cables between the couplers, master controllers and connection boxes are run in iron pipe. The rheostats are mounted similarly to the contactor boxes, being supported from iron brackets by moulded insulation bolts. These iron brackets are also insulated from the car framing.

These and other provisions insure the most perfect protection from fire caused by any possible short circuit or arcing, as practically all of the wiring and live parts of the equipment are insulated from wood work by fireproof insulation or piping.

## ELECTRIC RAILWAYS

The past few months have witnessed a very healthy and encouraging increase in railway business, not so much in special or novel orders but along the more profitable lines of sales of standard apparatus.

The following is a record of contracts for the past four months:

**Contracts Passed**

Railway Department:

| | |
|---|---|
| January | 58 |
| February | 47 |
| March | 73 |
| April | 81 |

## IMPORTANT INSTALLATIONS

### Boston & Maine Railway

About eight months ago the Boston & Maine Railway completed an electric road connecting the cities of Concord and Manchester, N. H., and paralleling the steam road. There were originally purchased for operation on this line four 4-motor GE-67 equipments with the Sprague-General Electric system. This electric division operates entirely on overhead trolley system. The division is operated in accordance with general steam railroad practice and has been most successful during its short period of operation.

This company has recently placed with us additional orders for eighteen 4-motor GE-67 equipments with Sprague-General Electric control, to operate upon the same division.

This installation is of interest, as the apparatus was purchased by a steam railway and is used to operate a branch line. For a full description of the B. & M. installation, see *Street Railway Journal* for December 6, 1902.

### Seattle & Tacoma Elec. Ry., Seattle, Wash.

The Seattle & Tacoma Electric Railway is a high speed interurban third-rail road connecting the towns of Seattle and Tacoma, Washington, a distance of 32 miles, of which 28.5 miles is private right of way. Overhead trolley is used at the Seattle end of the road for a distance of six miles from the center of the city. Power is brought from a 60-cycle hydraulic power plant and induction motor-generator sets are used in the sub-stations.

The sub-station apparatus and motor equipments were supplied by the General Electric Company.

This road has been in operation only a few months, and will be a competitor of the Northern Pacific Railroad for the traffic between Seattle and Tacoma. The distance by the steam railroad is greater and the schedule time of the steam trains is one hour and twenty-five minutes, and that of the local electric service one hour and a half.

**Equipment**

Number of sub-stations 3.

Average distance apart 12½ miles.

In each sub-station there is installed:

One 300-Kw. motor-generator set and in addition there is installed a storage battery

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made by the Electric Storage Battery Co., having an hourly rate of 640 amperes.

Transmission voltage 27,000.

The motor equipment consists of 10 equipments with four GE-66 motors and Sprague-General Electric control.

For a more detailed description see *Street Railway Journal* of May 2, 1903.

### United Railways of San Francisco

In our last issue, mention was made of the fact that electric companies in most of our large cities were installing high tension alternating current central stations and distributing power to sub-stations. A very good example of this class of installation is furnished by the United Railways of San Francisco. This company is the result of the consolidation of a number of properties in San Francisco. After the consolidation, the need of a large central station became very apparent and plans were formulated embracing the whole system, power to be distributed from sub-stations. The General Electric Company secured the order for the generating and sub-station apparatus. The order for the generating apparatus includes four ATB 22-1200-136, 13,200-volt generators. Power will be transmitted at 13,200 volts to three sub-stations. In one of these sub-stations there will be located six HC 10-750-300, 600-volt converters with complement of transformers and switchboard apparatus. The second sub-station will include three HC 6-500-400, 600-volt converters with transformers and switchboards. The third sub-station will include two HC 6-500-500, 600-volt converters with transformers and switchboard.

Each of these sub-stations is so arranged as to admit of increasing the number of machines that are now being installed.

In addition to the above, we have recently secured its order for fifty 4-motor GE-1000 equipments, and fifty 2-motor GE-1000 equipments.

The general manager of the United Railways is Mr. George F. Chapman, who was formerly general superintendent of the North Jersey Street Railway Company, of New Jersey. Mr. F. F. Bodler, master mechanic of the United Railways, was also formerly connected with the North Jersey system.

For a detailed description of this installation, see *Street Railway Journal* of April 18, 1903.

### Rockland, Beloit & Janesville, Wisconsin

In the last issue of the GENERAL ELECTRIC REVIEW brief mention was made of the electrical equipment of this road. Your attention is called to a very interesting article in the *Street Railway Journal* of April 25, 1903. This article contains a description of the road; it also gives some operating results, records of receipts, cost of power, etc. All electrical equipment of this road was furnished by General Electric Company.

### Canton & Akron Railway Company, Canton, Ohio

This is a typical electric interurban railway. The General Electric Company furnished the complete electrical equipment.

### Power House Sub-station Apparatus

There are two 450-B, 13200-volt generators; one 800-B, 13,200-volt generator; two 300-Kw., 600-volt rotaries, together with auxiliary apparatus, five sub-stations—the first known as "A" sub-station, seven miles south of Akron city limits; second, known as "B" sub-station, five miles north of Canton; third, at Masillon: fourth, at Beach City: fifth, at Canal Dover. Each of these five sub-stations has one 300-Kw. rotary.

The company has eight 57-foot cars, each equipped with a four-motor GE-73 equipment. Only three of these cars are in regular service. They run between Canton and Akron, making the round trip in three hours, time divided as follows:

Between Canton and Akron city limits, 21 miles of suburban road, in 60 minutes.

Between Akron city limits and the center of Akron they run over the local Akron Railroad Co.'s lines three miles in 20 minutes.

A 20-minute layover is made at Akron, and they return to Canton in an hour and

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twenty minutes as above, making in all three hours.

The road runs along in the public highway so much of the way that the use of the third rail was not practicable.

The rotaries in the "A" and "B" substations, when the 57-foot cars are in service have a swinging load up to 800 or 900 amperes, though the average load is nearer 100 amperes. All the rotaries and generators are operating splendidly. The generators frequently have an overload of over 100%, or more than double their full load rating, fairly slowing the engines down.

We have recently received a very satisfactory letter from Mr. Geo. W. Rounds, General Manager, reading as follows:

> The electrical apparatus furnished by your Company for the Canton-Akron Railway, as well as for the Canton-New Philadelphia Railway Company, has been installed as we understand completely, in accordance with the contracts which were made with your Company. The apparatus has worked very satisfactorially, and we think has been installed as it should have been. No trouble has been experienced with it, although it has been called upon to do duty far in excess of its rated capacity. I am sending a copy of this letter to our Boston office for their information.

### Aurora, Elgin & Chicago

A previous issue of the GENERAL ELECTRIC REVIEW contained an article on this installation and gave a list of the apparatus in use. One of our representatives has just made an inspection of the road and reports:

"I was very much impressed with the way the wiring work has been done around this station and it is a very creditable exhibition. They perhaps have more room than is necessary but this is a good fault. I consider the station as it is operated at present as most creditable to our apparatus, especially due to the fact that the load is so very irregular and they have no trouble due to the irregular load.

"I watched the generator ammeter and saw it swing from 150% load to 50% load in ten seconds. This was during normal operation. While watching the ammeter for five minutes, it went from practically zero for a minimum to 150% load for a maximum. The engine which they have running had a variation of 6%, inside of five minutes varying from 72½ to 77.

"It seems very evident that conditions here would very fully warrant the installation of storage batteries."

### Philadelphia & Reading Ry. Co.

The above company has built an entire new locomotive repair plant in North Reading, and after careful consideration decided to use electricity for the transmission of power.

The plant consists of three AQB 48-400-150, 440-volt, 60-cycle, two-phase, revolving field alternators; and one (1) AQB 36-200-200 generator of the same type.

This current is used to operate induction motors, driving groups of tools, except in the case of the larger tools which are direct driven.

The shops are equipped with electric cranes of 5 to 120-tons capacity, operated by direct current motors and to secure this current there are installed in the power house two (2) QC 8-150-900, 250-volt rotary converters operating in multiple. From the center of the secondary of the transformers for these rotaries a neutral connection is brought out and used as a neutral for three-wire direct current 125-250 volt system. This current is used for the cranes at 250 volts and the two voltages are used in connection with the variable speed tools.

The induction motors are of the Form K type without compensators. The motors are started by the use of a four-pole, double-throw switch so arranged that on one side the motors are supplied with current at about 70% of normal voltage and when speeded up the switch is thrown over to the running position.

In addition to the power service mentioned above they are operating 125 series A.C. arc lamps in their shops and yards and are installing 125 more. These will all be operated from six 50-light constant current transformers.

By the arrangement of apparatus in this case they have secured alternating current

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for constant speed service, direct current for variable speed motor service and can use the A.C. for transmission along the line of their railway to comparatively distant points if necessary.

### D., L. & W. R. R. Co.

The above company has a number of comparatively old mines located in the Keyser valley just outside of the city limits of Scranton. These mines are very close together and the inside workings are connected. They are all operated by steam and the haulage is done by mules. The pumping has been done by a large number of small pumps located in the various dips and sumps in the different mines.

By careful investigation it was found that a very large saving could be effected by the installation of a central power plant located at the lowest point or basin of the coal field. The water from the various mines will drain to this basin and be hoisted in large buckets to the surface, a distance of over 500 feet, at the rate of about 9000 gallons per minute. This can be done at night and the entire section pumped out in 14 hours.

It was therefore decided to install an alternating current plant of 1500-Kw. capacity, and we originally bid upon engine-driven alternators but when the customer saw our steam turbine he decided to install these. We have furnished three (3) 500-Kw., 2300-volt, 60-cycle, three-phase, turbo-alternator sets which are now in course of construction. These will furnish current to two (2) 800-H.P. induction motors operating the above water hoists. This point is not quite decided upon as they may use smaller units and more of them. Current will be supplied to three (3) 150-Kw., 275-volt rotary converters located at three different mines and also to one (1) 200-Kw., 275-volt rotary converter operated at a fourth mine.

These rotary converters will furnish current to 21 mine locomotives of 7 and 13-tons capacity, a number of electric slope hoists and several centrifugal pumps. To secure condensing water for the Central Station one water hoist will be operated all day and deliver water to a reservoir supplying the condensers.

In connection with this installation we are furnishing five locomotives equipped with cable reel device for chamber work and four others arranged to receive the device.

The plant will effect a very great saving and pay for itself in a very short time, at the same time increasing the output of the mines.

### The Mediterranean Railway—Italy

The following is an extract from the Annual of the Mediterranean Railway Co.:

"The affluence of passengers on Whitsunday the 18th May, 1902, required the addition of 21 special trains, or a total of 67 trains for the day and all of a seating capacity in excess of the normal.

In view of the constant increase of passenger traffic it was not possible to satisfy the demand with the usual number of trains provided by time-table. It was necessary to increase the number of cars of trains scheduled and to put on a certain number of special trains. On the 16th of June the total number of scheduled trains from Milan to Gallarate had been increased to 32, and from Gallarate to Varese to 23, not including the special trains.

This increased electrical service with a limited number of motor cars was only maintained by a notable increase in operation expenses due to the necessity of more frequent inspection of equipments, usually accomplished by night.

On ordinary holidays the scheduled trains could not handle the passenger traffic and special trains were always required.

During the holidays of the 15th, 16th and 17th August, three times as many passengers were carried as on the same days of the preceding year, and this with the number of motor cars absolutely inadequate for the service when accomplished under the ordinary service conditions.

The number of passengers carried on the 7th, 8th and 9th of September again exceeded

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the total of any of the days of exceptionally great passenger traffic already mentioned.

On these several days the number of cars per train was always in excess of the normal and many special trains were in service. On the 8th of September a total of 86 electric trains were run and in view of the unprecedented passenger movement four steam trains were required. On this occasion it was easy to note the preference of the public for the electric trains rather than take the special trains hauled by steam locomotives.

The total number of trains scheduled for the 16th June was continued throughout the summer and until the 15th October. On this date it was possible to discontinue only a single train in view of the continued affluence of passengers.

"On the 3rd November a slight reduction was made in the number of scheduled trains, leaving 24 trains between Milan and Gallarate, and 17 between Gallarate and Varese. The special holiday trains were also discontinued.

It is evident from these details that the electric train service on this division has always been satisfactory to the traffic manager and to the electrical engineers. Very few difficulties were met with and these were all in isolated cases and of slight importance. They may be each and all ascribed to special causes and not to radical defects or to the special system of electrical traction employed.

"The public also manifested its appreciation of electrical traction by the affluence of passengers requiring the use of the entire electric rolling stock to its utmost capacity.

During the first year's operation of this division by electric traction 7,000,000 car miles have been run by the electric trains against 3,000,000 train miles by steam in 1897. The passengers receipts from 1st December, 1901, to the 31st August, 1902, notwithstanding the reduction in fares, amount to 993,150 lire ($191,678) against 663,000 lire ($127,959) for the same period of the preceding year.

A more precise appreciation of the importance of the passenger traffic during the holiday periods above mentioned will be obtained by reference to the traffic receipts for the 15th, 16th and 17th August, 1902. On these three days the total receipts amounted to 50,014 lire ($9,653) against 22,990 ($4,437) for the same period of 1901, notwithstanding the reduction in fares. These figures also demonstrate that at least three times as many passengers were carried on these August holidays as on the same days in 1901."

There are at present in operation on this road twenty 4-motor GE-55 equipments, operating entirely on third rail system. The Mediterranean Railway have recently placed an order with our Mediterranean Company for three additional 4-motor GE-55 equipments and sixteen 2-motor GE-66 equipments, with Type M control, for operation on this same division. The above report and the placing of such large additional orders indicate the satisfaction of the Mediterranean Railway with the electrical operation of steam lines and their appreciation of the advantages to be obtained from the change from steam to electricity."

### Sprague-General Electric Control

The success of the The Sprague-General Electric control in this country has been reflected to a gratifying degree by recent foreign orders for equipments of this type. We have already mentioned the contract for the North Eastern Ry., England, which was secured by the British Thomson-Houston Company for manufacture under G.E. patents.

The largest of these is that of the Central London Ry. (another contract awarded to the British Thomson-Houston Company), including 64 double motor GE-66 equipments comprising the equipment for 32 trains. These motor car trains will replace the large equipment of gearless locomotives originally supplied by us four years ago and will make possible a material decrease in total train-weight as well as enable the road to maintain a higher schedule speed.

Other installations of importance are the Paris-Orleans Ry. with a recent order for five four-motor GE-66 equipments with Sprague - General Electric control, and

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the Anhalt Suburban Ry., Hamburg, Germany, which is using 18 double-motor GE-66 Sprague-General Electric equipments.

The Sprague-General Electric control will see its first installation in Japan in the near future, contract having been closed last fall with the Kobu Ry. for 16 double-motor GE-53 equipments for operation on the train control system.

## ELECTRIC LOCOMOTIVES

Certain classes of service not adapted to motor car systems find that the electric locomotive offers the best solution of the problem of electric haulage. Three years ago, after practical demonstrations made in the presence of French engineers on the tracks of the General Electric Railroad an order was placed with us for eight 50-ton locomotives for the Paris-Orleans Ry., these locomotives being used to haul the trunk line trains through a two mile tunnel between the old terminus of the road and a new station, located in the residential district of Paris. Three more locomotive equipments have recently been ordered from us similar to those previously furnished, and it is intended now to utilize both the old and the new locomotives in hauling trunk line trains, not only between the two city termini, but also to carry a number of the trains a considerable distance out on the main line before the steam locomotives are coupled on. Complete articles on the equipment of the Paris-Orleans Railway will be found in *Traction and Transmission*, Vol. 1, p. 225, and in the *Street Railway Journal* Dec. 21, 1901 and Nov. 15, 1902.

### B. & O. Locomotives

A flattering recognition of the success of heavy electric traction in tunnel work is shown by the B. & O. Railroad in increasing their equipment for the Baltimore Tunnel by the purchase of two additional electric locomotives. These locomotives are now in process of construction, and will weigh 150 tons each.

They differ very radically from the first locomotives furnished this company, being much simpler in design and more accessible in construction, and equipped with the latest improvements in controlling apparatus. The whole design affords the greatest flexibility of operation.

Each locomotive is made up of two 75-ton units. The two units forming a 150-ton locomotive will be coupled together and operated with the Sprague-General Electric control. The control is so arranged that each section may be operated independently, or any number of sections coupled together and operated from any one section.

The service required is to handle a 1500-ton train, exclusive of electric locomotive, on the B. & O. trunk line through the tunnel over an .8 of 1% grade at a speed of 10 miles per hour and over a 1½% grade at a speed of 9 miles per hour on 625 volts.

The motor equipment of each unit consists of four GE-65 motors of about 200 H.P. each with special slow-speed winding.

In mechanical design the construction of each unit is exceedingly simple, being composed of a massive rectangular framework of cast steel, 26′ long by 8½′ wide, surmounted by a capacious cab. The framework is made up of two massive side frames, each weighing 10 tons, connected by solid end frames, machined and bolted on. The side frames have slotted jaws, protected by wearing shoes for the journal boxes. The weight of the locomotive is carried on powerful half elliptic springs whose ends rest upon the top of the journal boxes. The locomotive is equipped throughout with modern appliances, including a special form of friction draft gear.

The large cab, 24′ long by 8½′ wide by 8′ 10″ high, is formed of sheet steel. Within are located the two small master controllers in opposite corners, and the remainder of the control, braking, air compressing, protective and measuring apparatus conveniently placed so as to be easily accessible for inspection.

## HIGH VOLTAGE INDUCTION MOTORS IN TEXTILE WORK

The application of the induction motor to cotton mill work is perhaps more extensive

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in the State of South Carolina than in any other portion of the country, but heretofore the voltages employed have not exceeded 600, taken either direct from the generator or from the secondaries of transformers attached to high potential transmission lines.

The General Electric Company has, however, recently sold to the Apalache Mills, near Greenville, S. C., an equipment consisting of 650 Kw., 2300 volt, ATB generator, for direct connection to water wheel; 250 H.P., three-phase synchronous motor; two 100 H.P. and two 75 H.P, three-phase induction motors, all to be run without the intervention of transformers.

About 60 Kw. transformer capacity is provided for arc and incandescent lighting. The distance from the generator to the various motors ranges from 600 to 800 ft., and the full load line loss from generator to center of distribution, using 0 wire, which is the smallest size desirable for the primary current of .160 amperes, is $\frac{3}{4}$ of 1 per cent. This is based upon a power factor of 80 per cent., an extremely conservative estimate in view of the large percentage of synchronous load and the small percentage (not over 30 Kw.) of the load composed of arc lamps. From the center of distribution to the various induction motors, the use of No. 4 wire for the 100 H.P. motors and No. 6 for the 75 H.P. motors keeps the drop down to $\frac{1}{2}$ of 1 per cent, so that in no case does the loss between generator and motor exceed $1\frac{1}{4}$ per cent., the synchronous motor being located at the center of distribution. From this center the various motor and lighting circuits are controlled by standard panels equipped with oil switches, and additional oil switches are located on the columns for the individual control of the induction motors, which are of the inverted type for ceiling suspension.

The requirements of the Underwriters' Association are met without any radical departures from the best standard practice in 600 volt work, with the exception that for interior work the wire used is rubber covered and insulated to withstand 10,000 volts pressure, and an additional fireproof outer braid required.

All high potential lines running vertically are provided for by vitrified conduits laid in channels in the walls, except the lines running down columns to the motor switches, which lines are incased in flexible "A.C.L." conduits.

Provision against unbalanced lighting load, and danger from weakened transformer insulation concurrent with ground on the primary lines, is made by wiring the lights on three-phase four-wire system, the neutral or fourth wire of the "Y" connected secondary lighting system being securely grounded.

Obviously the use of high potential motors direct connected to machines or line shafting greatly increases the disparity in favor of electric drive from the standpoint of efficiency as compared with any form of frictional drive.

This installation will shortly be followed by a similar one at Ware's Shoals, near Laurens, S C., and while it is in no sense a radical departure from established practice, it is worthy of note as being in line with the modern tendency toward higher voltages, secondary, as well as primary; and the approval by the Underwriters of the use of this high voltage directly in the manufacturing rooms of textile mills scores a point in favor of General Electric appliances.

## NEW APPLICATION OF INDUCTION MOTORS

The American Sugar Refining Company of New York City has placed an order for five Form K, induction motors for driving sugar centrifugals. The centrifugals are used for washing and removing the excess of water in the sugar. The cycle of operation consists in starting from rest and reaching full speed in about three minutes, running at this speed for about 7 minutes, current thrown off and speed brought down to about 400 R. P. M., allowed to run idle for about 5 minutes, the speed falling meanwhile to about 175 R. P. M, current thrown on and the centrifugal brought to full speed and so run

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for 12 minutes. The complete cycle takes about 30 minutes. The centrifugal revolves about a vertical axis. The induction field is built in a frame and the armature of the motor is mounted on the same shaft and directly below the revolving part of the centrifugal. A motor drive so arranged offers a number of advantages over belt drive. The centrifugal can be more quickly brought up to speed, no valuable space is taken up by belts, and it can be more easily operated.

## LARGE INDUCTION MOTORS

Among the large induction motors manufactured in the last few years is the I 40-800-180, Form K, 2080 volt motor for the Anaconda (Mont.) Copper Mining Co. This is the largest motor in size that we have built although one or two exceed it in output. The motor is used to drive an air compressor. It is provided with a sub-base, 4 bearings, a friction clutch and a grooved pulley for rope drive. The friction clutch allows the motor to start light and gradually take its load after reaching full speed. The pulley is 6′ 6″ in diameter, giving a rope speed of about 3700 ft. per minute, and is grooved for 20 $1\frac{3}{4}$″ ropes. Ropes are less liable to slip than belts, due principally to the fact that they tend to wedge between the sides of the grooves. They are therefore much used for installations of this kind which require large units of power. The bearings of the motor proper are placed in the end shields and are adjustable both horizontally and vertically. This construction allows accurate adjustment of the air gap, a point that is very important when the gap is as small as we use on induction motors.

The I 10-1000-300, Form M, 2200 volts motor is another large motor. It was built for the U. S. Rubber Reclaiming Co., Buffalo, N. Y., and used to run rubber rolls.

It is provided with sub-base, four bearings and a pulley for rope drive. The armature shaft and pulley shaft are joined by couplings forged as part of the shafts, thereby materially shortening the motor. The external resistance is used only while starting the motor. When the motor has reached full speed the armature winding is short-circuited by a switch operated by a conveniently located lever. As far as operating conditions are concerned this is a Form L motor. The difference consists in placing the resistance outside of the motor instead of in the armature. In motors of large size, the amount of energy dissipated while starting is very great which necessitates the use of heavy resistance and large contacts for carrying the current. These conditions are more easily met by placing the resistance and controller outside and employing a short-circuiting switch as has been described.

### Operation of Traveling Cranes by Induction Motors

The Michigan Central Railway Co. has recently installed a three-phase, 60 cycle, 440 volt power plant for its shops at Jackson, Mich. Two ATB 36-200-200, 480 volt and one ATB 26-60-276, 480 volt direct connected compensated type generators furnish the power. Form K induction motors are belted to small groups of machines throughout the shops, and incandescent and arc lighting is supplied from the same generators over separate feeders.

In the main shop there are two 60-ton traveling cranes, built by the Whiting Foundry Equipment Co., of Harvey, Ill. These two cranes are equipped with General Electric Form M induction motors as follows:

Main Hoist—I 14-30-514, 440 volt.
Auxiliary Hoist—I 12-20-600, 440 volt.
Bridge—I 14-30-514, 440 volt.
Carriage or Rack—I 10-7.5-720, 440 volt.

The motors are well mounted and geared for their respective work. The controllers are conveniently located for the operator in the carriage, and the rheostats are assembled under the operator's seat in the carriage. Alternating current solenoids automatically release brakes on each motor when current is turned on.

The cranes have been in regular service for about three months, and are entirely satisfactory. The control of the motors is as perfect as is obtained with direct current series motors, and the cranes are as easily

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operated. Besides the usual shop work, these two 60-ton cranes are frequently worked together in transferring a locomotive from one set of trucks to another. The main hoist of each is attached to one end of the locomotive, which is raised off its trucks, carried to another part of the shop and placed on another set of trucks. The nicest adjustment of speed control is required in doing this work. Locomotives, however, are transferred very frequently, and the work is done quickly, and without the least inconvenience.

Volt-ampere readings taken on the different motors show that the sizes were well selected by the Whiting Foundry Equipment Co. The maximum variation of voltage at the motor terminals is from 8 to 15%, depending on the character of the work. The variation of voltage at generators, however, is very much less, and as the lighting circuits are on special feeders, the voltage regulation does not seriously affect the lighting.

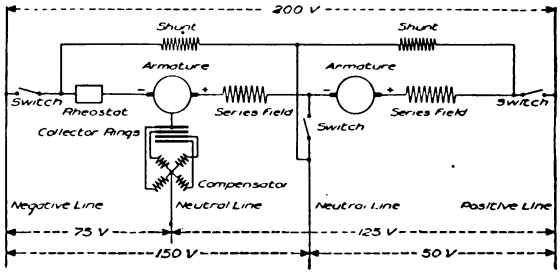
## 4-WIRE BALANCER SET FOR SHOP TOOL MOTORS

There has recently been tested a four-wire balancer set manufactured by the General Electric Company, and it operated in a very satisfactory manner.

The set was built for the Natal Government, South Africa, and is to be used in connection with 119 small motors driving shop tools. The set was made from two of our 17½ Kw. moderate speed generators one wound for 150 volts and the other for 50 volts. The 150 volt machine has a quarter-phase collector ring connected to the back end of armature, thus deriving a neutral from this machine as well as another neutral from between the two machines. By this arrangement we can obtain five different voltages, 50, 75, 125, 150 and 200. The set was connected as follows:

The set was operated at the following capacities:

| | | | |
|---|---|---|---|
| 50 | volts | 15 | Kw. |
| 75 | " | 15 | " |
| 125 | " | 25 | " |
| 150 | " | 35 | " |




Another strong point in favor of the four-wire balancer is the fact that we can obtain 200% speed variation with standard CE and CA motors, instead of furnishing expensive motors. It might be suggested that it would be possible to connect a quarter-phase collector to the second machine and thereby obtain a five-wire system.

## THE CONSTANT CURRENT TRANSFORMER IN NEW ENGLAND

It is natural that the street lighting system using series alternating enclosed lamps controlled by constant current transformers should be quite widely used in New England, since this system was developed at the Lynn factory and the first installation was made at the station of the Hartford Electric Light Company, Hartford, Conn., well known for its progressiveness and willingness to try new devices which seem to possess merit. The first transformer, a thirty-five light, was installed in April, 1898. This was followed by two 100-light units a few months later and the total capacity is now 800 lights. The success attending the Hartford installation may be gathered from a statement made by Prof. W. L. Robb, Consulting Engineer of the Hartford Company, at a meeting of the National Electric Light Association, two or three years ago. Prof. Robb had read a brief paper on the "Hartford system," as it is sometimes called, and one of the central station men asked if he had found it necessary to have a spare transformer to use in case of damage to one of those in service. He replied that he was under the impression that in the early days a spare transformer was included in the outfit, but that it had never been found necessary to use this and that it had

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been loaded with lamps years ago. This has been the general experience, although in the large installations in this section, it is quite common to include a spare transformer fitted with flexible leads, of a suitable length to permit it to be readily put in service in place of any transformer which may be disabled. These leads are provided with union couplings and it is the work of but a few minutes to put this transformer in service without moving any apparatus.

The constant current transformer, popularly called by the New England central station people the "tub transformer," has been installed in about seventy New England stations. These installations comprise :

| | | |
|---|---|---|
| 5- | 25-light | transformers, |
| 9- | 35 " | " |
| 138- | 50 " | " |
| 11- | 75 " | " |
| 44- | 100 " | " |

of which 112 are of the air-cooled type. The Boston office has not sold a single 60-cycle, oil-cooled, since the development of the air-cooled transformers. The total number of arc lamps installed is a little over 8000, of which number 1658 are 7½ ampere, and 633 are the new, plain type, "Central Station."

As is well known, it is desirable, before throwing constant current transformers on to the station bus-bars, to place the coils in position of maximum reactance. The usual method of accomplishing this is to raise the weights in the morning, after the lights have been shut down, and support them by means of a wooden stand. This stand, of course, has to be removed at the time of starting up. As it requires considerable effort to raise the weights on a 100-light transformer, station men have shown considerable ingenuity in devising ways and means of accomplishing this operation. In a good many stations a rope has been attached to the lever and led to a pulley above the transformer. By means of this rope the lever has been raised just before plugging in the primaries. This device requires the service of two men, one at the transformer and one at the switchboard, unless the transformer is so located that the rope may be led to the switchboard.

Frequently transformers are located in the basement or in parts of the station removed from the switchboard, and in a number of such cases station men have devised mechanical devices to hold the coils apart. These devices are more or less automatic in their action, requiring that the coils be separated by hand, but automatically releasing the lever when the primaries are plugged in at night. One of these devices consists of a cast iron plate fastened to the case of the transformer. Through a hole in the side of this plate a bolt projects which is normally drawn back by means of a spiral spring. In the morning the attendant raises the lever by hand and pulls out the bolt, which is held in this position by the lever and its weights. At night, when the primary switches and the secondary short-circuiting switch are plugged in, the lever rises slightly and the spiral spring causes the bolt to snap back, thus permitting the lever to drop below it. The constant current transformers at the station of the Quincy Electric Light & Power Company, Quincy, Mass., are equipped with magnetic starting devices furnished by the General Electric Company. These devices are superior to any mechanical device, since they are entirely automatic in their action. They will not, however, probably come into very general use on account of the introduction in the near future of a starting resistance with time limit switch which applies the primary voltage in two steps, thus preventing too rapid separation of the coils and at the same time preventing a drop a voltage on the commercial feeders attached to the same bus-bars.

At a number of places constant current transformers are thrown on from a distance, and, in some cases, from a distance of several miles, without the use of any such devices, and while we do not recommend this practice, no bad results have been experienced.

The installation of constant current transformers on the lines of the Narragansett Electric Lighting Co., Providence, R. I., presents some features of special interest. This

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company uses the series alternating system for lighting suburban towns from sub-stations, having seven 100-light transformers and two 50-light transformers, all of which are oil-cooled. The 100-light transformers are of the early form, having an open-circuit voltage of 9600. They are wound for a primary voltage of 10,000, and are installed in sub-stations about fourteen miles from the generating station. Some trouble was experienced with the first installation, due to the primary coils puncturing. Careful tests showed that these failures were due to excessively high voltages, caused by a resonant condition of the lines which consisted of 12,000 ft. of lead-covered, 10,000-volt, underground cable, and eleven miles of overhead wires. The lines were protected (?) by complete installations of non-arcing metal gap lightning arresters of a well-known make, with numerous reactive coils. These, apparently, were of no assistance in protecting the transformers from high voltage discharges which, by actual tests, reached about 30,000 volts, but which, judging from some of the insulation which was destroyed, may have risen to 50,000 or even 100,000 volts. After numerous experiments, the lines were protected by spark gaps, consisting of standard G E. lightning arresters, connected across the primary lines and also to ground in the way now shown in the lightning arrester pamphlet. These devices have furnished complete protection for some years, and the other lightning arresters and reactive coils have been removed entirely, as the Providence people came to the conclusion that they had much less trouble without them than with them.

The first street lighting circuits connected to these transformers consisted of 40 to 50 miles of waterproof wire, of all sizes from No. 6 to No. 10. The lines were in very bad condition as the Narragansett Electric Light Company, after purchasing the local plants, was unable to rebuild the lines before it was necessary, in accordance with its contract, to operate the street lights. The result was considerable leakage in current and a number of pyrotechnic displays caused by the burning of the pole tops. The school children were in the habit of hanging to the iron pole steps driven into the wooden poles, for the sake of the pleasurable sensation of the slight electric shock thus obtained.

The street lights in the towns of Warren and Bristol are operated on a midnight schedule. The firemen find the lights so necessary that the chief of the fire department has arranged with the sub-station attendant to have the lights thrown on after midnight in case of a fire. As the attendant is in bed at this time, he has arranged matters so that he can push a button in his bedroom and throw a switch in the sub-station which throws on the constant current transformers.

While the street lighting of the city of Providence proper is not as yet performed by constant current transformers, it may be interesting to mention a unique way of operating series incandescent lamps. Providence has 5000 series incandescent lamps; probably the largest number operated by any station in the country. Most of these are operated from old T.-H., L.-D. and M.-D. arc dynamos, from which the air blasts and commutators have been removed and the latter replaced by two-part collector rings. The armatures have been reconnected and the fields are externally excited. The result is a single-phase alternating dynamo having a capacity of between 4000 and 5000 volts, at a frequency of 16 cycles per second. On account of the thick filament of the 6.6 amp. series incandescent lamp, the light given by the lamps does not give any evidence of the low frequency at which they are operated. A year or more ago, it became noised about the country that the Narragansett Company had some new-style 16-cycle alternators, and this company was honored with visits from several distinguished electrical engineers from all parts of the country, who were anxious to investigate this new system.

The Narragansett Company has found it convenient and economical to use series alternating arc lamps for lighting shore resorts, dance halls, etc. This is also done by the Suburban Gas and Electric Co., Revere,

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Mass., which lights Crescent Beach and other resorts on the north shore.

A beginning has been made in using series alternating systems for mill lighting. We have two such installations, one consisting of three 50-light, air-cooled, 60-cycle transformers, with 150 lamps, installed in the mills of the Amoskeag Mfg. Co., Manchester, N. H., and the other of one 50-light, oil-cooled transformer with 50 lamps, installed at the Washington Mills of the American Woolen Company, Lawrence, Mass. This installation is of special interest as it is operated at 40 cycles and the electrician states that the operatives notice practically no difference between 60-cycle and 40-cycle lamps.

The series alternating system seems peculiarly adapted for mill work since the objections to the use of high voltage secondaries for commercial lighting do not apply with so much force to mills as to stores, and therefore, a mill is able to avail itself of the many advantages of the series system. The series lamps are steadier than the multiple and the system is entirely automatic. The globe breakage is probably 50% less with series lamps than with multiple lamps, used as they ordinarily are in mills. In mill work, it is desirable to keep the wires on the ceilings as few as possible, and also to be able to move these wires readily since the location of machinery is changed occasionally, and it is then necessary to move the lamps. In such cases, the wire used in the series system may always be used over again while with the multiple system, much of it will not be of a size suited to the new locations. With multiple lamps there is a large number of cut-outs to maintain, and these are apt to be broken and to cause trouble through the blowing of fuses. Moreover, many of the old mills are already wired for old-style, series, open arc lamps and in such cases, it is very economical to put in the series enclosed system. Experience has proved that the old wiring can always be used and, where any change in insulation is necessary, it is comparatively slight, involving only the installation of porcelain cleats or knobs. Another disadvantage of the multiple system for mill lighting is that if all the lamps on the multiple transformer are to be thrown on at one time, which is ordinarily the case, it is impossible to install arc lamps to the full capacity of the transformer, on account of the blowing of fuses. Experience shows that it is necessary to put not more than twenty 6-amp. lamps on a 15-Kw. transformer, while 25 could be installed if they did not all have to be lighted at once. Of course these lamps might be divided into groups of three or four, but this requires a multiplicity of switches and cut-outs together with a system of wiring which is most undesirable for mill installations.

The number of alternating enclosed lamps necessary to replace open arc lamps, differs considerably with the character of the work and the amount of illumination to which the operatives have been accustomed.

The use of series incandescent lamps for street lighting is more general in New England than in any other section of the country. Probably the second largest installation is at Malden, Mass., where the Malden Electric Company has about 3000 series incandescent lamps operated from constant current transformers, each having a capacity of 50 arc lamps but wound for 5½ amperes. These transformers replaced a large number of old-style bank boards, with very gratifying results both in reliability of operation and in economy. The lamp renewals with the new system are just about half those with the old system. While the electrician of the Malden Electric Company anticipated increased circuit troubles on account of the higher voltage used, he has found that these troubles have actually been decreased 60%. As to economy of operation, the rearrangement of circuits at the time the constant current transformers were installed, resulted in taking down over $3000 worth of wire, and the lamp renewals have been decreased about $2000 per year. In addition to this installation, we have about half a dozen other installations of smaller size.

In addition to constant current series incandescent installations the New England territory has sixteen installations of RD

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reactive coils operating incandescent lamps at different currents; 1¾, 3, 3½ and 5½ amperes. One of these, on the circuits of the Newton & Watertown Electric Co., Newton, Mass., is of special interest. It consists of 14 reactive coils wound for 5½ amperes. The circuits do not return to the station. One pair of mains are run out from the station and the incandescent lamps are connected in series between these mains, each series with its reactive coil. The reactive coils are installed in wooden boxes on platforms attached to the poles. Wooden blocks have been placed between the coils of the regulators so as to keep the floating coil from coming to the maximum load position, thus always keeping enough reactance in the coil to prevent bad results at the time of throwing the current on to the mains from the central station switchboard. The operation of the coils under these circumstances is perfectly satisfactory and the illumination is much better than heretofore, since the current is kept steadier, the candle power of the lamps is uniform over all of the territory, and the light is of a better quality than before the regulators were installed. The steadiness of current is indicated by the fact that records kept for several months show that the amount of energy used with the reactive coil system is 18% less than with the old system. The lamp breakage, however, has not decreased very much, due chiefly to the fact that most of the breakage on the Newton circuits is caused by boys who seem to take a special delight in using the lamps as targets.

The following partial list of the larger cities in New England lighted by the series alternating system may be of interest:

Fitchburg, Mass.
Malden, Mass.
Holyoke, Mass.
Brookline (including a number of lights within the city limits of Boston).
Salem, Mass.
Lynn, Mass.
Brockton, Mass.
Quincy, Mass.
Woburn, Mass.
Lowell, Mass.
Chelsea, Mass.
Portland, Me.
Bangor, Me.
Keene, N. H.
Concord, N. H.
Dover, N. H.
Rutland, Vt.
New London, Conn.

## NEW ENGLAND INSTALLATIONS

### The Globe Newspaper Co., Boston

On Oct. 31, 1902, there was started at the Boston Globe plant the first Type M equipment as re-adapted for printing press control. This equipment has been in continuous successful use ever since the very first day. The owners of the Globe are very much pleased with its simplicity, reliability and perfect ease and steadiness of control. They have recommended it to many other newspaper companies. We have recently completed the installation by the addition of an ammeter for each motor, placing the same on a single panel with the several switches and enclosed fuses. Prospective customers can be referred to this plant at any time, with the certainty that they will be shown every attention and will be strongly advised to order the same equipment rather than any other make on the market.

The following letter showing the results obtained from our linotype motors will be of interest:

BOSTON, MASS., February 17, 1903

GENERAL ELECTRIC COMPANY,
200 SUMMER STREET, BOSTON, MASS.

GENTLEMEN:—

Referring to our experience in the use of your motors for driving linotype machines individually, would say that, with the exception of six, we formerly drove all of our linotypes from a line of shafting operated by a single motor. The six machines referred to were driven by motors mounted on the machines and geared to the main shaft. In November, 1901, we had occasion to consider some rearrangement of our linotype room and the methods of driving the machines, owing to the installation of a number of new linotypes.

We thoroughly investigated the various motors offered and various appliances for driving, with the

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result that it was finally determined to purchase seven of your special Linotype Motors with Automatic Belt Tightener Heads for belt-connection to our linotypes, — this being a trial order to afford us opportunity of making a comparison between the reliability, flexibility and cost of your method as compared with the use of line shafts and other methods which we had previously employed.

Our experience with the seven motors was so satisfactory in every respect that in July, 1902, we gave an order for twenty-three (23) more of your linotype motors; later, this was increased by an order for five (5) more, making a total of thirty-five (35), which are now driving that number of linotype machines with the most satisfactory results.

We thoroughly endorse the method of driving linotypes by the use of individual belted motors. The outfits are quiet in operation, have not been at all troublesome to keep in repair, and the cost of operation has certainly been less than when our machines were driven from a distance by a large motor with long lines of shafting and many bearings.

The belt between the motor and the linotype relieves both machines of the racking vibration unavoidable where pinions and gears are used; the decreased cost of operation is largely owing to the fact that, with individual equipments, each motor may be stopped when the linotype it is driving is not being operated. Furthermore, we can very quickly take a motor from one machine and attach it to another, if necessary. This flexibility of equipment is of great importance in large printing offices, especially in case any accident befalls one of the machines.

Our experience with these motors, under the operative conditions encountered in the severe service of a great metropolitan daily, has been all that was claimed for it.

Yours very truly,

(Signed) DANIEL A. DAVIS,
Machinist in charge of Boston Globe Newspaper Co. Linotype Dept.

### Manchester Traction, Light & Power Co., Manchester, N. H.

This company has recently placed its order with us for two ATB 40-650-180, 12000-volt, DS-2 generators with station equipment. This will make four generators, while the station is arranged for two additional generators. The current will be transmitted about 14 miles to Manchester, where it will be used in connection with other water-power plants and a central steam-power plant for combined lighting, railway and power purposes.

### American Steel and Wire Co., Worcester

This company has just placed its order with us for one 250-Kw. and three 500-Kw., 125-250 volt, 150-revolution, direct driven, direct current generators. One 500-Kw. unit will be used at the South Works as an addition to the two 100-Kw. and one 200-Kw. units now in use there. The three remaining generators will be used at the North Works to replace six belted, Form H generators of 75-Kw. and 85-Kw. capacity. At each one of its Worcester Works this company now has several hundred horse-power in General Electric motors, of from 95 H.P. down, in addition to several thousand lights.

### Taunton Municipal Plant, Taunton, Mass.

This company is very soon to start up the new three-phase plant referred to in the last REVIEW. It is branching out in power work and has recently contracted with the Huber-Hodgman Printing Press Company for power to run the entire new works. We have taken a contract from the Huber-Hodgman Company for two 20-H.P. and two 75-H.P., three-phase, 60-cycle, 220-volt induction motors. A number of other large power customers are in prospect. The sale of such large units of power is perhaps a little unusual for a municipal plant.

### Boston Manufacturing Co., Waltham, Mass.

This company has recently ordered of us a second ATB 20-500-360, 600-volt, belt-driven generator, together with several hundred horse-power in induction motors.

### United States Navy Yard, Portsmouth

We have just been awarded contract with the Construction and Repair Dept., for 41 CA and CE type motors.

### Berlin Mills Co., Portland, Me.

This company has just given us a contract for the electrical equipment of its new pulp and paper mill to be built at Gorham, N. H. The contract covers a 40-cycle water-power station equipment, consisting of three

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750-Kw., 12000-volt generators with exciters and switchboard outfit complete; pole line and sub-station, with four 750-Kw. step-down air-blast transformers with switchboard outfit and complete mill installation of over 3200 H.P. of Form L, 550-volt induction motors.

**The Rhode Island Co., Providence, R. I.**

This company has recently contracted with us for a motor-generator set consisting of one MP 8–500-300, 575 volts, D.C. generator, and one ATB 10–500–300, 11,000 volts, 25-cycle synchronous motor. This outfit is to be used as a connecting link between the alternating and direct current generating apparatus, serving either as a D.C. motor and alternating generator, or as an alternating current motor and a D.C. generator.

**Munising Paper Co., Munising, Mich.**

This company has just given us a contract for two 500-Kw., engine-driven, 600-volt, 40-cycle, three-phase generators ; one 50-Kw., engine-driven, 600-volt, 40-cycle, three-phase generator, with suitable exciter sets and a motor-generator set to be used in operating a 500-volt, D.C. tramway. The order includes over 1800 H.P. of slow speed induction motors.

## THREE-PHASE TRANSFORMERS

In 1901 and 1902, the General Electric Company acquired the right to manufacture three-phase transformers under the patents of Michael Von Dolivo-Dobrowolsky and Carl Kurda, these two patents broadly covering the essential features of the core and shell type three-phase designs. We began immediately developing lines of three-phase transformers for all kinds of lighting, power and railway work, and have had them on the market about a year.

A three-phase unit has many advantages over a combination of two or three single-phase transformers. It is well known that the cost of any installation can usually be reduced by substituting one large unit for a plurality of small ones The transformers are constructed as one unit, being connected across the three primary and the three secondary mains of a three-phase system. Such transformers are suitable for use where two or three single-phase units would ordinarily be installed. Constructed as a single unit instead of three, the same Kw. output will generally be obtained with higher efficiency, less weight and lower cost than two or three single-phase units.

Three-phase transformers have been developed in both the core and shell type designs, subdivided in about the same way as our single-phase transformers, that is, the smaller units are built in the core type design and larger units in the shell type. An economy in materials and weight has been effected in these designs as compared with the single-phase transformers necessary to accomplish the same results. In addition, the transformers have the following meritorious features.

By using a three-phase transformer, only one containing tank and cover are necessary instead of two or three as in the case of single-phase transformers. The floor space required for the installation is less and it is much easier to install a single-phase unit than to install two or three separate units. The appearance of a single three-phase transformer on a pole is very much more pleasing than two or three smaller single-phase transformers.

The location of terminals can be very conveniently arranged, the low and high tension leads being brought out on opposite sides of the tank. The smaller transformers can be readily suspended. The low tension leads are brought out of the side nearest to the pole so that they can be easily connected to the distributing mains which are generally below the transformer. The high tension leads can be just as readily connected to the high voltage mains which are generally above the transformer. Such an arrangement reduces the probability of short circuit, and the transformer is much more easily installed than two or three single-phase transformers of smaller capacity to transform the same energy. Transformers may be built in all standard capacities from 5 Kw. up to any

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capacity desired, and are furnished in oil-cooled, air-blast or water-cooled designs, depending upon the requirements of the installation.

Briefly, then, the advantages of the three-phase transformers may be enumerated as follows:

Minimum number of units.
Ease of installation.
Simplicity of connections.
Appearance.
Economy of investment.

It is interesting to note how quickly purchasers have recognized these advantages.

At the end of the last fiscal year, our sales amounted to 54,775 Kw. About 48,300 Kw. have been sold in connection with railway work; 3750 Kw. for lighting, and 2700 Kw. for power work.

Three-phase transformers, in view of the advantages above mentioned, will have a wide field.

Bulletins and descriptive matter will be issued shortly, and every effort should be made to see that stations using three-phase distribution are carefully advised as to the merits of our three-phase transformers. They contain all the meritorious features of our single-phase transformers, and none of the points of superiority in these designs have been sacrificed in the production of our three-phase line.

## TRANSFORMER BUSINESS

The past year has been a notable one in transformer business Our sales have shown a marked increase over the preceding year and had we been able to increase our factory facilities rapidly enough to meet the demand, it would have resulted in still greater increase, as many orders have been lost solely on the question of deliveries. Our factory facilities for handling transformers of all capacities are unexcelled, but the year's demands have severely taxed them.

Very radical changes and additions have been found necessary and are under way to enable us to cope with the situation. We are just completing a commodious building at the Lynn works which will be largely devoted to the production of transformers of 50 Kw. and less. Extensive additions have been made to the Schenectady factories producing transformers and still another factory will soon be erected for the manufacture of transformers exclusively.

During the year, the General Electric Company received orders for approximately 478,225 Kw of transformers of all sizes which is an increase of 80% over orders of the preceding year.

The year has witnessed a number of new developments in all lines of transformer work. A complete line of three-phase transformers has been developed and placed on the market. These are described elsewhere in this issue. Improvements and redesigns in Type H transformers, 50 Kw. and less, have been effected.

It is interesting to note that engineers generally are giving the transformer situation careful study and the characteristics of transformers are being more and more carefully investigated before orders are placed. Our constantly increasing sales furnish a strong endorsement of our claims to superiority.

### Transformers Over 50 Kw.

Our complete and varied lines of large transformers for all kinds of railway, lighting and power work are giving unusual satisfaction wherever installed and have the hearty approval of the Electrical Fraternity. This is evidenced by the fact that our orders for transformers of over 50 Kw. have shown such an enormous increase from year to year.

It would take too much space to enumerate all of the important deals of the year, but the following tabulation showing some of the orders, amounting to over 10,000 Kw. each, will prove of interest:

**Kern River Co., Los Angeles, Cal.**

27 750-Kw. transformers, aggregating 20,250 Kw, 2200 volts low tension, 25,000 and 39,000 volts high tension, water-cooled.

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**Twin City Rapid Transit Co., Minneapolis, Minn.**

24 transformers, varying capacity, aggregating 11,850 Kw., rotary voltage low tension, 13,200 volts high tension, air-blast.

**St. Louis Rapid Transit Co.**

15 1100-Kw. transformers, aggregating 16,500 Kw., 430 volts low tension, 6600 volts high tension, air-blast.

**Old Colony Street Railway Co., Boston, Mass.**

30 transformers, varying capacity, aggregating 14,415 Kw., rotary voltage low tension, 13,200 volts high tension, air-blast.

**Canadian Niagara Power Co., Peterborough, Ont.**

12 1250-Kw. transformers, aggregating 15000 Kw., 11000–38000 volts low tension, 11000–57000 high tension, water-cooled.

**Transformers 50 Kw. and Less**

The difficult situation through which we passed last year needs no special comment. Nothwithstanding the above, our sales report for the last fiscal year showed a material increase. The future delivery system has received hearty support with gratifying results, this system insuring us of the entire business of a very large percentage of the central stations of the country, and enabling us to schedule our production on standard transformers in such a way as to effect economy in cost of construction. Another advantage gained is the ability to make prompt and immediate shipments. Both of the above advantages have benefitted the purchaser.

## BRUSH ARC GENERATORS

We have just completed four unusual installations of Brush Arc Generators.

For the Consolidated E. L. & P. Co., of Kansas City, Mo., we supplied six No. 13-B machines with three ATB 6-180-500, 6600-volt synchronous motors; two arc dynamos connected by buffer couplings to each motor —one on each side—making three three-unit motor-generator sets. The motors are started from rest with starting compensators, no load on the arc machines.

In the power house of the South Park Commissioners, Chicago, we have placed four No. 13-B machines, which are belt-driven from a Corliss engine with a four-crown pulley. The shafts of the generator are extended 32″ and equipped with Weller friction clutch pulleys. The clutch pulleys permit of any machine being thrown out of service without disturbing the other three.

The City of Chicago has just put into service the second of what might be termed a 5-unit set, consisting of five No. 13-B Brush Arc machines, with specially heavy and extended shafts, the machines being coupled together with buffer couplings, the fifth machine being coupled to the extension of the shaft of a grooved pulley set between two heavy bearings, the unit being rope-driven. A dummy shaft is kept on hand, which can be put in place of any armature, so that in case of an armature being disabled, it can be quickly taken out, the dummy shaft put in its place and service furnished from the other four machines. The city officials say that the first of these sets, which has been in operation for about two years, is the most satisfactory of the many arc equipments they are operating.

The Oak Park (Ill.) Construction Co., operating 250-volt direct current machinery over a limited territory, secured the city lighting contract, and purchased from us two 10,000-volt, 5-ampere machines, each direct connected to an 85-H.P., 250-volt direct current motor. The area to be covered by the arc service was too great to permit of the use of multiple lamps from the 250-volt circuits, and the above arrangement was believed to be the best and most efficient. Aside from a small auxiliary unit in a Wisconsin plant this is the only station using Brush Arc machines driven by direct current motors.

## ARC LIGHTING

**Buffalo Installation**

One of the largest Series Direct Current Enclosed Arc Street Systems has recently

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been installed at Buffalo including 3200 arc lamps. The new system replaced 9.6-ampere open arcs, while the brush machines which formerly operated at 9.6 amperes were changed over to 6.6-ampere current. The new type lamp was designed especially for Buffalo, and its strong advantages, both mechanically and electrically, have led to its adoption as a standard lamp for the future. A bulletin is being compiled which will describe the Buffalo installation and the lamp in detail.

### North Adams Installation

A second large order for new Series Direct Current Lamps was taken at North Adams recently, covering 600 lamps. Competitive tests in connection with this order were of a very thorough character. One of our principal competitors sent to the factory two or three times for new special lamps, hoping to make a stronger impression than had been possible with lamps taken from stock. Our new lamp showed greater merit on account of superior electrical design, which permits of closer arc voltage regulation than any lamp heretofore designed by this Company, or any other arc lamp manufacturer.

### Erie Installation

The third large order for "Buffalo" type lamps, was secured at Erie, covering 700 lights capacity. The manager of the Erie Company visited Buffalo, and was so well pleased with the appearance and operation of the lamp that this order was placed with us purely from the standpoint of merit.

## NEW FORM 6 SERIES ALTERNATING LAMPS

The General Electric Company now manufactures and sells a complete line of closed base inner globe lamps for interior and street use. The new Form 6, Series Alternating Current Street Lamp is very popular. Below is a list of recent installations.

| | | |
|---|---|---|
| Augusta, Ga. | . . | 400-lights capacity. |
| Spokane, Wash. | . . | 200 " " |
| Richmond, Va. | . . | 700 " " |
| Detroit, Mich. | . . | 400 " " |

## LARGE ORDERS RECENTLY TAKEN FOR SERIES ALTERNATING STREET SYSTEMS

| | | |
|---|---|---|
| Sacramento, Cal. | . . | 400-lights capacity. |
| San Jose, Cal. | . . | 225 " " |
| New London, Conn. | . . | 235 " " |
| Newburgh, N. Y. | . . | 315 " " |
| Evansville, Ind. | . . | 375 " " |
| Youngstown, Ohio. | . . | 450 " " |
| Concord, N. H. | . . | 140 " " |
| Brockton, Mass. | . . | 300 " " |
| Lynn, Mass. | . . | 315 " " |
| Nashua, N. H. | . . | 250 " " |
| Janesville, Wis. | . . | 225 " " |
| Detroit, Mich. | . . | 300 " " |
| Spokane, Wash. | . . | 272 " " |

## ILLUMINATING ENGINEERING

A new era in connection with artificial lighting has reached us. Illuminating Engineering is fast becoming an absolute necessity in connection with interior lighting matters. The time has passed when arc lamps can be placed promiscuously—high or low, far apart, or near together, in accordance with the whim of the customer, or the opinion of the wire man.

Merchants have come to look upon artifical light as a strong power in their business. They appreciate the superiority of the enclosed arc compared with all other artificial lights. The salesman can increase his sales by advantageously exhibiting goods under the enclosed arc. So forcibly have the demands of the mercantile people been presented, that the General Electric Company is now making a specialty of Illuminating Engineering. A bulletin is soon to be issued which is complete and furnishes valuable data and advice on Illuminating Engineering.

## REFLECTORS FOR IMPROVED LIGHT DISTRIBUTION

Various new designs of reflectors are being introduced by this company for all kinds of lighting effects. It is surprising to consider the variety of conditions which demand different shape or different style of reflecting surface, to secure proper distribu-

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tion. Below is a list of some of the classes of work in connection with which many varieties of reflectors have been recommended.

Armory.
Ship Building Plant.
Railroad Clearing Track.
Carbon Works.
Machine Shop.
Shirt and Collar Factory.
Foundry.
Woolen Mill.
Clothing Store.
Hat Store.
Dry Goods Store.
Jewelry Store.

## CONTRACT FOR LIGHTING THE GROUNDS OF THE ST. LOUIS EXPOSITION

The grounds of the St. Louis Exposition will be illuminated with 1800 G.E. alternating enclosed arc lamps. The reputation which our system has established for reliability and satisfactory service, enabled us to secure this large order, which includes eighteen 100-light constant current transformers and all arc lighting accessories.

## ARC LIGHTING BUSINESS OF THE NEW YORK EDISON COMPANY

During the entire year of 1902, the New York Edison Company used General Electric arc lamps, exclusively, and have purchased several thousand. The Speedway of New York was lighted with G.E. series alternating enclosed arcs. Recently another contract has been closed with the New York Edison Company for the entire lamp business for 1903, which covers approximately 5000 lamps. Most of the lamps are for street service in connection with changing over from the old open arcs to enclosed lamps. Considering the large number of arc lamps which they are using, it is gratifying to be able to advise that the most satisfactory service is being secured.

## MERIDIAN LAMP

It is interesting to note the favor with which the Meridian Lamp has been received by central station managers and their customers.

One customer writes:

"Kindly enter our order for forty additional Meridian Lamps complete. The few lamps we have put out have caused us considerable trouble, for the reason that everybody is so well satisfied with them that they are clamoring for more, and I am going to get into serious difficulty unless I can receive the shipment at once. Can you not help me out by expressing us at least one barrel of them at once, so that they will get here by next Monday or Tuesday. I really think that they are away ahead of the ——— Lamps, and in evidence of this I will say that a customer who is now burning four ——— lamps, and who paid a good sum for them, was in the office this morning and placed an order with us for sixteen of the Meridian Lamps. If you can help me out in this in any way, it would be a great favor and I would appreciate it very much."

Another customer writes:

"Three of the Meridian Lamps are installed in the Peabody Store and they are giving very good satisfaction. In fact, they are better than the ——— Lamp that he has. I hope in a short time to be able to install more of them."

A large manufacturing concern in Chicago is now lighting its office with individual incandescent lamps on each desk. The lighting is not satisfactory, so they have asked for quotations on a 40-Kw., 240-volt, 60-cycle generator to be operated by a 60-H.P., 500-volt D.C. Motor, for the purpose of running 800 lamps of another make. We have interested them in the Meridian Lamps and have now a number installed to show what they will do We think we can light the office satisfactorily with Meridian Lamps at a cost less than the cost of the ——— lamps alone, saving the expense of the special 240-volt generator.

## ALTERNATING CURRENT FLYWHEEL GENERATORS.

This type of engine-driven generator is larger in diameter than the ordinary type and the rim of the revolving field is heavy enough

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to maintain the necessary uniformity of rotation without the use of a separate flywheel. The advantages of the type are shorter shaft, less stress in the shaft, less floor space, and in some cases a lower cost for the complete set than for a set using a separate flywheel.

We have adopted two methods of building the revolving fields of this type of generator. One is to use cast iron for the field spider and make it in halves, each half having the hub, arms and rim in one piece. The two parts are joined by bolts at the hub and steel I-keys at the rim. The field poles are fastened to the rim by steel bolts. On account of the simplicity of this construction it is used wherever the stresses produced by centrifugal force will allow, which is usually on machines of moderate output, and 25 or 40 cycles. In some cases the large diameter or the high speed of the machine will produce forces too great to permit of the construction just described. We then make the rim of sheet iron punchings, and fasten the poles by dovetails. The rim is so constructed that the joints in any layer of punchings are reinforced by the solid metal of several adjacent layers. The rim is firmly clamped together by numerous rivets. The small rim on which the punchings are mounted is divided into segments and these are cast as part of the arms. In the larger sizes the arms are made hollow in order to obtain the greatest strength with the use of the least material. The inner ends of the arms are firmly clamped between the halves of the hub which is divided in a plane at right angles to the shaft. By the use of sheet iron we obtain a material that is very reliable and the construction is exceptionally strong. Either type of revolving field above described will stand a speed of twice the normal without injury.

The first flywheel generators had the revolving field rims made of cast steel, but this construction was abandoned in favor of the methods mentioned above. The method selected depends on the requirements of the case.

It is not customary to have any movement of the armature of the larger machines because of its great weight, but access to the windings may be had by removing a few poles, which is easily done with either type of fastening.

Below are given the ratings and purchasers of the flywheel machines which this Company has built in the last few years. All of the machines have been installed except the 450B-Kw. generator for Lynn Gas & Electric Company, the 3500-Kw. generator for Twin City Rapid Transit Company and the 5000B-Kw. generator for Philadelphia Electric Company.

ATB 72-450B-100, 2300 volts, Form F.

ATB 72-800A-100, 2300 volts, Form F.

1 of each for Lynn (Mass.) Gas & Elec. Company.

ATB 72-675B-100, 2300 volts, Form F.

1 for Memphis (Tenn.) Light & Power Company

This generator is a duplicate of the 800-Kw. machine for the Lynn Gas & Electric Co., except in the matter of the flywheel effect.

ATB 80-800A-90, 2300 volts, Form F.

ATB 80-1200A-90, 2300 volts, Form F.

1 of each for Worcester (Mass.) Electric Light Company.

ATB 32-1500-94, 11,000 volts, Form F.

2 for Rhode Island Suburban Ry., Providence, R. I.

ATB 40-1500-75, 6600 volts, Form F.

3 for Sidney Tramways, New South Wales.

ATB 56-3500-75, 13,200 volts, Form F.

3 on order for Twin City Rapid Transit Company, Minneapolis, Minn.

Owing to the large diameter of the machine the armature frame must be very rigid. With the ordinary type of frame this can be secured only by excessive weight, therefore we have designed a frame one side of which is carried down alongside of the revolving field rim. This accomplishes the desired result of a very rigid frame with the use of a comparatively small amount of cast iron which is the material employed.

The rim is built up of sheet iron punchings and the arms of the spider are hollow steel castings.

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AQB 96-5000B-75, 6000 volts, Form F.

The construction is the same as that of the ATB 56-3500-75 above described.

1 on order for Philadelphia Electric Co., Philadelphia, Penn.

## ELECTRICALLY OPERATED CAPSTANS

The Department of Bridges, New York City has had in operation for two years an American ship windlass capstan operated by GE-800 motor, for pulling canal boats through Washington Avenue Bridge at Wallabout Basin.

This capstan has proved of considerable value in expediting the passage of canal boats through the bridge, and reducing the delay to traffic on the bridge to a minimum.

The New York, New Haven & Hartford Railroad Company, for railroad docks at Port Morris is operating two 75-H.P. motors with capstans for pulling boats in and out of the docks.

The New York Edison Company has just ordered two GE-57 motors with capstans for operating coal barges at its Waterside power station.

## 80″ PROJECTOR

Up to the present time, the largest searchlight projector ever constructed in the United States is one with a diameter of 60″, which is situated at Fort Wright, Long Island Sound, and is used for the coast defense of the United States Government.

An order has just been received from the Mail Order Publishing Company, St. Louis, Mo., for a searchlight projector which it to be the most powerful ever constructed. The diameter will be 80″, or 20″ greater than that of the Fort Wright projector. The current used will exceed very considerably that used in the largest projector heretofore built. This mammoth projector is to be used by the Lewis Publishing Company for advertising the Woman's Magazine, and is to be placed on top of their new building which is located near the St. Louis World's Fair grounds.

## 1000-KW. FREQUENCY CHANGER SET

We have on order for the Chicago Edison Company four frequency changer sets composed of

Motor ATB 10-1000-300, 9000 volts.

Generator ATB 24-1000-300, 4150 volts.

The sets are reversible, either machine operating as a motor or generator. When operating as a generator at 1000-Kw. output non-inductive load, the 25-cycle machine will have an inherent regulation of 12% and the 60-cycle machine a regulation of 6%. The efficiency of the set is about 90%.

The set has but two bearings, which materially reduces the floor space. There is also no trouble from improper alignment of bearing, a difficulty that is quite apt to occur in sets of more than two bearings unless unusual care be taken.

The armature frames drop below the floor line, and should a regular base be used, closed at the ends, it would not be possible to slide the armatures along to the space usually occupied by the bearing standards, consequently in order to facilitate the work of erecting and dismantling we have provided the machine with foundation rails for supporting the armatures and the bearing standards which span across the rails at each end.

The first two sets furnished the Chicago Edison Company had a grooved pulley in the place of the 60-cycle machine, and the 25-cycle machine was run as a generator. Later the 60-cycle machine will be substituted.

## LIGHTNING ARRESTERS AS LINE DISCHARGERS

Whenever lines contain both inductance and capacity in noticeable quantities, high voltages which endanger the insulation of the whole system are likely to exist. We, therefore, frequently find such abnormal voltages in lines containing a combination of underground and overhead circuits and in long transmission lines.

The General Electric Company has devised a method of connecting its lightning arresters so as to protect against lightning

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and at the same time to act as a safety valve and discharge the high voltage as rapidly as it accumulates. These high voltage conditions in a great many cases may not be recognized by the central station manager, unless they are called to his attention by the frequent breaking down of insulation, and even then the troubles are often ascribed to other causes. The strains very often produce pin-hole punctures in the insulation of underground cables and thus relieve themselves temporarily; they may therefore remain unnoticed for a number of months until the insulation becomes very much impaired, ultimately resulting in a complete breakdown.

It is very difficult to detect the existence of these excessive voltages with switchboard instruments commonly in use. In the first place, most voltmeters are installed on potential transformers. When these abnormal pressures exist, the wave is of enormous high frequency and will not appear on the secondary side of the transformer due to the fact that the eddy current set up in the iron by the high frequency is so great as to dampen out the wave and prevent its reappearance on the secondary side, but it is difficult to measure this pressure even with such instruments as electrostatic voltmeters installed directly across the high pressure wires. This is because the wave is of short duration and its intergrated value is so small and the time element of the moving mechanism of the instrument so large comparatively that the instrument will not record the disturbances. Practically, we have found that only spark gaps of some form of wave meter which records instantaneous values is of any service whatsoever for such measurements. We have carefully investigated the subject and found that our alternating current arresters, specially installed and connected, would perform the functions of protecting against lightning or resonance, or other high voltage disturbances on the lines. The arresters are installed directly across the lines, the center of the arrester being connected through an additional installation of arresters, so proportioned that there are the same number of gaps from either line to line as from line to ground.

As above pointed out, these abnormal pressures frequently exist and produce serious injury before their presence is recognized by the central station manager. The arresters connected so as to protect against these phenomena cost practically no more than for the ordinary protection against lightning. They should, therefore, be generally recommended for this work. You are requested to read carefully Mr. Wirt's Circular Letter No. 186, explaining the matter fully, and to recommend this method of installation wherever there is any possibility of high voltage phenomena existing; in fact, it would be safest to recommend it in all cases.

If these points are carefully explained and appreciated it should result in extended use of our arresters for such protection. There should be a large field for this work and the business should be cultivated.

### Oil Well Equipments for the Standard Oil Co.

We have recently sold 200 pumping equipments for oil wells controlled by the Standard Oil Co. These equipments are to take the place of gas engines previously used. Each equipment consists of a 10 H.P. three-phase induction motor and a T–18 controller. The controllers provide for the operation of motors at full and half speed and are reversible. Owing to the danger from inflamable gases, all circuits in these controllers are opened under oil. For pumping, the motors are operated at half speed. In cleaning the wells, it is necessary to operate the motors both forward and reverse at full speed.

### Circuit Breakers for Railway Equipments

We have recently developed a new line of circuit breakers especially adapted for use on railway equipments, known as the MR type. This line of circuit breakers includes at the present time four sizes. These circuit breakers are now in production and will hereafter be considered as our standard types for use with railway equipments.

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| | | |
|---|---|---|
| MR–2 | 15 to 45 amperes | 0 to 14 H.P. |
| MR–3 | 50 to 150 amperes | 15 to 49 H.P. |
| MR–4 | 100 to 300 amperes | 50 to 99 H.P. |
| MR–5 | 200 to 600 amperes | 100 to 199 H.P. |

The ampere ratings indicate the maximum and minimum tripping points for which the circuit breakers can be set. They are suitable for railway or other intermittent service where the equipments are operated at full H.P. but a small portion of the time. It must be understood that the H.P. ratings of these circuit breakers is upon an intermittent basis.

These circuit breakers are of very compact construction, all parts being incased in metal casing. They are arranged to be tripped by hand by moving the handle backward toward the off position.

## ALTERNATING CURRENT IN COAL MINES

Interesting applications of high potential alternating currents to mines are those of the Berwind–White Coal Mining Co., near Altoona, Pa., and the Webster Coal and Coke Co., at Ehrenfeld, Pa.

The power house of the Webster Coal and Coke Company, contains two 150 kilowatt electric belt driven double current generators, separately excited, and deliver direct current at 275 volts from one side and three-phase alternating current at 165 volts from the other side. The direct current at 275 volts is fed into the outer end of the mine haulage circuit in the usual manner, one terminal of the generator being connected to the trolley circuit and the other to the rail return. The potential of the alternating current taken from the double current generator is raised from 165 volts to 5600 volts to by step-up transformers. This current is then transmitted by three conductor, rubber insulated, lead covered cables to the sub-station, which is situated in the mines. At these sub-stations the current is then reduced by the means of transformers, and fed to rotary converters, from which the direct current is lead to the trolley and rail return.

The double current generators in the power house are simply rotary converters being duplicates of the convertors in the sub-stations, with their shafts extended to receive the driving pulley. It is proposed, as the occasion requires, to remove these two generators from the power house aud establish additional rotary converter sub-stations in the mines beyond the present sub-station.

A 300 kilowatt engine driven revolving field alternator has recently been installed in the power house and delivers 5600 volt, three-phase current direct to the transmission lines without the interposition of step-up transformers. A duplicate unit will be added at a later date and direct current for the outer end of the haulage circuit will probably be supplied by the rotary converter located in the transformer room of the power house.

These interesting installations are fully described in an article in the *Electrical World and Engineer* of March 7, 1903.

## WIRE AND CABLE

Recently large orders for wire and cable have been received of which the following are perhaps the most interesting:

New York Edison Company—

125,000 ft. of 1,000,000 C.M. 2-cond. concentric cable.

125,000 ft. of 250,000 C.M. 3-cond. cable, both paper insulated.

Also 26,000 ft. of rubber-covered cable, varying in sizes from 1,500,000 C.M. to 750,000 C.M.

We are also filling this company's order for

21,000 ft. of special weatherproof cable of three sizes, viz.: 1,500,000, 1,000,000 and 750,000 C.M.

Rochester Gas & Electric Company—

This company ordered rubber cable amounting to

35,200 ft. varying in size from 1,000,000 to 500,000 C.M.

9,000 ft. 2-cond. 00 cable and

11,000 ft. 3-cond. 0000 cable.

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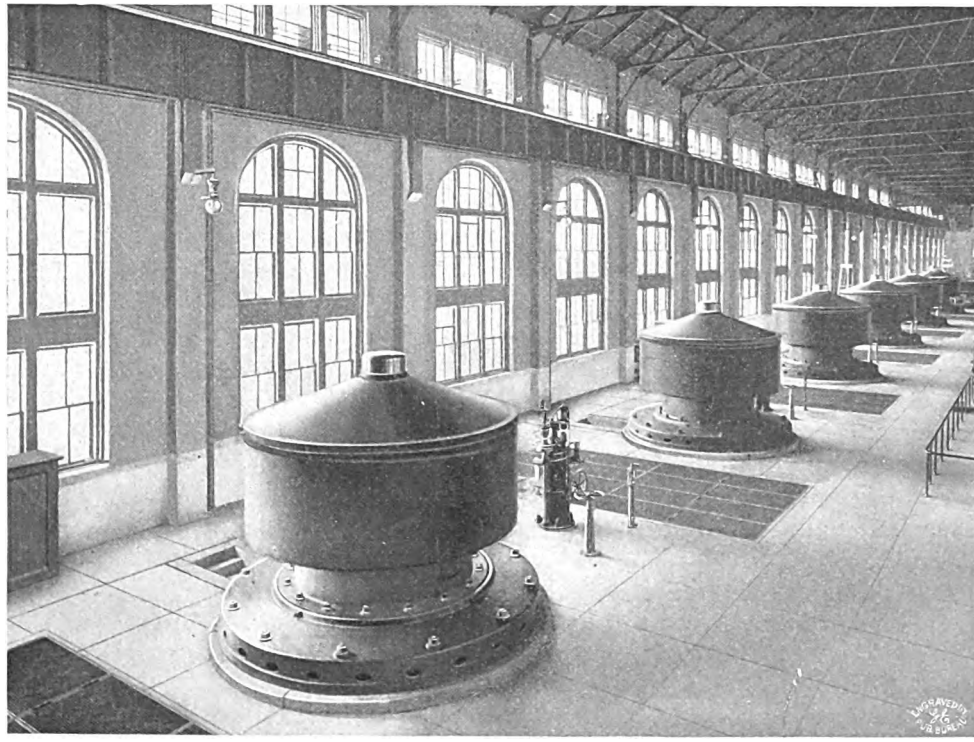

SIX 3750 KW. GENERATORS IN NIAGARA FALLS POWER COMPANY'S POWER HOUSE NO. 2

## NIAGARA FALLS POWER COMPANY—GENERATORS

The last of the six AQB 12-3750-250, Form A generators supplied by the General Electric Company was put in service in Power House No. 2 of the Niagara Falls Power Co. in March, 1903, and all six have been in continuous commercial service since then. The machines are built for 2200 volts, quarter-phase, and are similar in capacity, voltage and some of the general features of design to those in Power House No. 1, on the opposite side of the canal.

The principal points of resemblance to the old machines are the external revolving field structures supported by an umbrella shaped spider, and the arrangement for cooling the armature cores and bearing jackets by

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circulation of water. One of the prominent points of difference is the placing of the slip rings for the field current of the new machines at a point on the shaft below the guide bearings, thereby doing away with the bridges that overtop the old machines for the sole purpose of providing access to the rings. The rings on the new machines are so placed that they can be conveniently reached by simply descending a few steps below the main floor to a space beneath the machines. In this space are also placed the valves controlling the flow of oil to the guide bearings, the catch basins for the out-flowing oil, the valves and catch-basins for the cooling water, and the insulated main terminals of the armatures. The compartments inside the machines are entered through this same space. It is possible to go into the body of the machines, and move freely all around between the shaft and the armature while the generator is in full service, without any chance of coming in contact with live or moving parts. A noticeable feature is the strong draft of air utilized for the ventilation of the generator. The course of this ventilating current is most direct. The air passes through the ducts provided in the armature core and thence out between the layers of the winding of each field spool, freeing itself through holes provided in the outer ring. There are no fans provided, as the draft is sufficient without.

In Power House No. 1, the weight of the machines is carried by the upward thrust of the column of water which supplies the energy to the turbines. The force with which the shaft is raised is therefore somewhat dependent upon the load that is being carried. In Power House No. 2 the turbine shafts are equipped with oil thrust bearings to which oil is supplied under pressure. These shafts also have balancing pistons at the bottom which receive pressure from an independent column of water, so that the upward thrust on the new machines is taken care of in two ways, and is entirely independent of the load being carried by the generators.

Among the interesting power house tests made on these machines was the sudden short circuiting of both phases of the armatures under full speed and normal voltage. This was accomplished without injury of any kind. The machines were also run at a speed of 400 revolutions per minute.

The regulation of the machines is within 10%, and the effect of loading one phase to its full current capacity and leaving the other phase light is scarcely noticeable in the difference in voltage of the two phases.

The machines are very simple to handle. The removal of the field and driver leaves all parts accessible. The end of the shaft is tapered to receive the hub of the driver. These parts are lifted by the use of a large steel eyebolt equipped with a hydraulic pump for loosening the driver from the shaft before lifting.

The forged nickel-steel field ring of one of the machines was exhibited in the Electricity Building at the Pan-American Exposition. This part with field spools, pole-pieces and spider assembled on it, weighs about 42 tons and is the heaviest piece to be handled.

The machines were delivered promptly, and installed as fast as the foundations and turbines were prepared for them.

The General Electric Company is now beginning to install in this power house five additional machines of the same rating as the above, but having internal revolving fields. The new machines stand 9′ 11″ high above the cap stones of the foundation and measure 14′ 10″ in diameter, making them 1′ 8¾″ lower, but 3′ larger in diameter than the external field machines.

Five 7500 Kw., 11,000 volt, three-phase internal revolving field machines are now being built at the Schenectady Works for the power house of the Canadian Niagara Power Company. The first of these will probably be installed in January, 1904. The Canadian Power House will be operated in multiple with power houses No. 1 and No. 2 on the New York side by using three-phase-two-phase transformation.

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## RAILWAY APPARATUS

### NOTES ON THE ELECTRICAL EQUIPMENT OF THE SUBURBAN SERVICE OF STEAM RAILWAYS

Electrical apparatus has now been developed to a point where its application to many of the steam railway systems is a matter of sound business policy. This fact is beginning to be realized by railroad men who have been impressed with the results obtained by many of the electric systems already installed. Electric traction is now the best, and, in fact, the only way to materially improve the service, handle trains in tunnels, increase car mileage, raise schedule speeds and solve many other difficult problems now confronting steam roads.

A study of the conditions which will probably exist in the future, shows that present facilities for surburban traffic will be entirely inadequate, and that radical steps will have to be undertaken to satisfactorily meet the conditions. The steady growth of population and the increasing separation of the business and residential centers, due to better traffic facilities, present a most serious problem, and the only solution seems to be electrical operation.

In steam railway practice the handling of suburban trains, in many cases, seems to be a secondary consideration, and is simply handled in conjunction with other traffic, therefore, any change looking to the betterment of conditions, and any attempt to entirely isolate the suburban traffic and place it on a first-class basis will surely result in a tremendous increase in the number of passengers carried. Wherever electrical apparatus has been installed, two facts stand out very prominently as a result of such equipment:

First, increase of speed.

Second, more trains per day.

In fact, speed, convenience and cleanliness are the essence of the whole question, and are the factors which create and draw traffic. Most people are unwilling to live more than an hour's ride from their place of business. Any increase in speed therefore extends the hour limit and permits the passenger to cover more distance in the given time. The area available for suburban residences increases as the square of the increased distance. For instance, a change in the hour limit in all directions from 20 to 25 miles means a change in area to draw from, roughly in the proportion of 2 to 3, therefore a slight increase in speed means a very material increase in traffic.

The General Electric Company has within the last year submitted several complete reports on the practicability of electrically operating the suburban service of some of our large steam railway systems. In each case it has clearly been demonstrated to be a wise step to install electrical apparatus. There is no doubt that within the next two years active steps will be taken by many of the large steam railways to install electrical apparatus on parts of their systems, or to investigate its feasibility very carefully.

Within the past month a complete and accurate report has been made covering the electrical handling of the suburban service of one of the eastern steam railways, and while the matter is only in a preliminary state the results indicate that the railway is fully warranted in making this substitution in motive power. A brief synopsis of this report is of interest:

Length of system, approximately 25 miles of double track.

Cost of equipping 25 miles of double track, $2,100,000.

Credit for 18 steam locomotives now in use, and for 30 pairs of trucks, all of which may be transferred to another division, $210,000, making net investment, including cost of generating station, motive power, third rail, underground transmission line, sub-stations, underground transmission lines for lighting and miscellaneous motors, $1,891,850. This figure therefore covers the entire expense of substitution outside of the real estate for generating and sub-stations.

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The cost per mile of single track is $40,000

Trains will consist of two, three and four cars, each car being a motor car equipped with two GE-66 motors operating at a maximum speed of 40 M.P.H. A schedule speed of 23 27 M.P.H. with stops of 30 seconds each, .9 mile apart, will be maintained. The cost of operating the system electrically as compared with steam is very interesting. The present steam system consumes 80 tons of coal per day, costing at $2.45, $195.70. From actual test it was found that the coal consumption amounts to 8 84 pounds per I.H.P. hour on the assumption of an engine efficiency of 80%. (This equals, for the sake of comparison, 14.82 pounds per Kw.) This coal consumption also includes all coal used in firing up, also that used while the engine is running light or switching.

This figure is rather high due to the fact that stops are frequent, and a considerable layover occurs between some of the trains. At best a steam locomotive is very inefficient for this class of service.

Recently in making certain investigations of the New York Central suburban service it was found that the coal consumption was about 6.9 pounds, being somewhat lower than the figure given above due to a more improved type of locomotive. The steam consumption per H. P. in this class of work is from 60 pounds up.

The detailed operating cost is given herewith; the figures are in cents per train-mile and are comparable as to size of train, that is, the seating capacity is the same for both steam and electric.

**Cost in Cents per Train-Mile**

| | Steam | Electric |
|---|---|---|
| Fuel for power house expense | 11.1 | 8.22 |
| Wages | 14.15 | 5.08 |
| Repairs and depreciation, motive power | 4.9 | 2.54 |
| Additional repairs and depreciation | | 1.135 |
| Oil, waste and supplies | .5 | .20 |
| Round house expenses | 1.5 | .20 |
| Total | 32.15 | 17.375 |

The present steam mileage is 1760 per day. The total expense for operating by steam and electric will be therefore as follows:

**Comparative Annual Cost of Steam and Electric Operation, on Basis of 1760 Train-Miles per Day**

| | |
|---|---|
| Cost of steam operation at 32.15 cents per train-mile | $206,200 |
| Cost of electric operation at 17.38 cents per train-mile | 111,200 |
| Saving | $95,000 |

This saving corresponds to 5% on the net investment of $1,891,850 required to equip electrically.

The electrical equipment given above can handle a service of 3300 train-miles per day, and on the basis of this train mileage the operating expenses would be as follows:

**Comparative Cost of Steam and Electric Operation on the Basis of 3300 Train-Miles per Day**

| | |
|---|---|
| Cost of steam operation at 32.15 cents per train-mile | $407,000 |
| Cost of electrical operation at 17.38 per train-mile | 220,000 |
| Saving | $187,000 |

This corresponds to 10% on electrical investment required.

Particular attention is here drawn to the fact that it is possible to obtain a very greatly increased train mileage with the same electrical apparatus as would be necessary to handle present traffic. Herein lies one of the most important advantages of an electrical equipment. In a suburban service where a certain amount of electrical apparatus is installed to fulfill a given service that is now being handled by steam it will be possible with this electrical apparatus to obtain, generally speaking, about twice the present car mileage now obtained from steam locomotives with practically no increase in operating expense. This advantage is enormous and needs no further comment.

In the above operating expenses for both steam and electric systems, all apparatus is supposed to be entirely renewed in from 20 to 25 years, with the exception of the buildings, foundations, and real estate. There is, therefore, a depreciation charge of from 4 to 5% to be charged against the apparatus in addition to

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a conservative estimate of the cost of the necessary repairs to keep the apparatus in good running condition. Disregarding this depreciation charge it is seen that there would be a total saving of 14 to 15% on the electrical investment over the present cost of operation by steam on the basis of same train mileage per day, or, in other words, the operating expenses electrically would be 50 to 55% of the operating expenses by steam.

These figures are no exception to others made under similar conditions where service stops are frequent, acceleration heavy and therefore weight of steam locomotives high in proportion to the seating capacity of the train.

The steam locomotives, with their crew and the train and train crew, while nominally in service for ten hours or more, are actually in effective service only from four to five hours per day. The remainder of their time is taken up in layovers. The engine crew in the mean time give considerable attention to the locomotive. The saving in wages with electrical operation is therefore considerable, as the crews and cars can be sent out for other runs with little delay, the necessity for lay over is reduced to a minimum. The saving in wages together with the difference in the cost of power forms the major portion of the saving.

The General Electric Company has also recently made a very careful investigation and report of the New York Central local service. Some of the interesting results are as follows:

The proposed service extends on the main line from Forty-second Street to Croton, a distance of 34 miles; and on the White Plains division as far as North White Plains, a distance of 25 miles. It is proposed to equip, approximately, 140 miles of single track. The operating expenses given below are for local trains only, which will be operated with motors under each car, with the Sprague-General Electric system of control.

**Operating Expenses, Steam and Electric, Cost ni Cents per Train-Mile**

| | Steam | Electric |
|---|---|---|
| Fuel for power house expenses | 21.8 | 21.4 |
| Wages, train crews | 11.95 | 7.42 |
| Repairs of motive power | 5.2 | 4 |
| Additional repairs, cables, etc. | | 1.5 |
| Oil, waste and supplies | .5 | .25 |
| Roundhouse expenses | 1.5 | .25 |
| Total | 40.95 | 34.82 |

The expenses given above are very high for the electric service, due to the very heavy trains required at infrequent intervals, resulting in a poorer load factor for the generating station.

Figures were also prepared upon the same service, and, in addition, it was proposed to handle the through trains on both divisions mentioned, and also the trains of the New York, New Haven & Hartford R. R. as far as Woodlawn, located 12.57 miles from Forty-second Street, with electric locomotives. With the operation of these through trains electrically, in addition to the local service, a very much better load factor is obtained, and, therefore, the cost of electrical operation is much more favorable.

**Comparative Cost of Operation, Steam and Electricity Including All N. Y. C., and N. Y., N. H. and H. R. R. Service Out of 42d St.— Cost in Cents per Train-Miles**

| | Steam | Electric |
|---|---|---|
| Fuel for power house expenses | 15 2 | 9.8 |
| Wages | 8.28 | 6.12 |
| Repairs, motive power | 5. | 2.2 |
| Additional repairs, cables, etc | | .65 |
| Oil, waste and supplies | .5 | .25 |
| Roundhouse expenses | 1.5 | .25 |
| Total | 30.48 | 19.27 |

The above figures are made out for the present train operation on the New York Central, and New York, New Haven and Hartford R. R. Load fluctuations are tremenduous, consequently the distributing system and sub-station capacity are very large for the average all-day load. Notwithstanding these unfavorable conditions, the cost of electrical operation is only 63% of the present

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steam operation, and as the total train mileage per day is approximately 8,000 it means a saving of $327,000 per year. There are many secondary savings which would necessarily follow, but which were not considered. Sufficient figures were obtained, however, to indicate the feasibility of the project, even though the conditions were very unfavorable in respect to infrequent heavy loads.

The principal point to be gained in the New York Central installation, however, would be the fact that the train mileage of the system could be practically doubled with the present track facilities; also the present nuisance of operating trains through the tunnel will be practically done away with.

The figures obtained from investigating the local travel of the New York Central road, upon both the main line and White Plains division, corroborate the favorable view taken in regard to electrically equipping other steam systems. The figures in case of the New York Central are not quite so favorable as those mentioned previously, due to the fact that the trains are much heavier and run at less frequency. Cars will weigh, with electrical equipment, approximately 55 tons each. Should the figures be reviewed under more favorable conditions, that is, using lighter cars, better utilization of the train crews, etc., the showing would be fully as favorable as that mentioned in the fore part of this article.

The substitution of electricity for steam as a motive power is not limited to the suburban traffic of our large steam roads, as is illustrated by investigating the possible substitution of electricity in several of the tunnels on the Great Northern, also Baltimore & Ohio, Southern Pacific, and other roads having heavy grades to overcome. In two of these cases water power was available, and in the third case steam power was used, but the results are the same in each case; that is, a saving in electrical operation sufficient to pay an adequate return upon the capital invested. All these figures were based on the use of direct current motors, but the possibilities of alternating motors for such work are also very great, and the General Electric Company is perfecting a motor which will operate from a single-phase circuit at high voltage and at the standard railway frequency of 25 cycles.

### OPERATING RESULTS MANHATTAN RAILWAY

The Manhattan Elevated is now practically equipped electrically, and very gratifying results have been obtained from both a traffic and operating point of view. The report of the Manhattan Railway Company to the State Railroad Commission for the quarter and nine months ended on March 31st has been published. The total number of passengers carried in the first three months of this year was 65,193,975; 58,037,249 in the corresponding period of 1902, and 50,448,918 in the same period of 1901. For the nine months the total number of passengers carried was 180,481,586, an increase of 22,921,489 compared with the nine months ended March 31, 1902. The gross earnings for the quarter showed an increase of $351,828, with an increase in operating expenses of only $63,750. This is construed as an indication of the economical working of the third-rail system. For the nine months the gross earnings show an increase of $1,127,888, with an increase in operating expenses of only $41,225.

These are certainly significant facts pointing to the fulfillment of the prediction of increased traffic made when it was decided to equip the system electrically.

### SPRAGUE-GENERAL ELECTRIC CONTROL

The N. Y., N. H. & H. R. R. has recently made its initial purchase of Sprague-General Electric Control apparatus for its Providence, Warren & Bristol branch to be used with GE-55, 4-motor equipments.

The Boston & Worcester St. Ry. Company opened its line from South Framingham to Worcester on June 24th. This is one of the longest street railway lines in the east. They have recently placed an additional order for GE-57, 4-motor equipments with Sprague-General Electric control for high speed interurban service.

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**CHICAGO & MILWAUKEE ELECTRIC R. R.,**
**Highwood, Illinois**

This electric railway is of interest as being the first to use storage batteries in connection with rotary converter sub-stations, and among the first to use alternating current transmission for railway work. The increase in traffic during the past few years has necessitated large changes and additions to the equipment. The provisions which were originally made to handle the service expected at that time have proved entirely inadequate, and although the fundamental lines upon which the plant was designed have been adhered to, a radical change in the size of units, etc., has been made which illustrates how ideas of electrical equipment have been modified within a comparatively short time.

A brief description of this road is as follows: The main line is 27 miles in length and extends north from Evanston—a suburban city 12 miles north of Chicago— to Waukegan, passing through 13 towns along the shores of Lake Michigan. Of this distance, about four-fifths—from Evanston to Lake Forest—is double track; the remainder is single track, but will be changed to double track in the near future. A double track branch 7 miles long is now being built from Lake Bluff, near the northern terminal of the main line, west to Libertyville. Although a large portion of the track is upon private right-of-way, this road, on account of the thickly settled nature of the district through which it passes, must be considered of the suburban rather than of the interurban type.

The first 15 miles from Highland Park to Waukegan were placed in operation in 1898, but the remaining 12 miles, between Highland Park and Evanston, were not completed until 1899. The original rolling stock equipment consisted of double-truck closed motor cars, 38 feet over all, and provided with two GE-57 motors. These motor cars performed the regular service, but the increased patronage during the summer months necessitated a number of trail cars.

The trolley line is supplied with direct current from a generating station located at Highwood, near the center of the line, and from two sub-stations, one at North Chicago, near the northern terminus, and the other at Winnetka, near the southern terminus. Each of these stations furnishes current for a distance of approximately 4½ miles in each direction.

The original generating station equipment consisted of two ATB 24-250-125, 5500 volt generators and one MP 6-250-125, 600 volt generator, all mounted upon quill shafts and connected to two Filer & Stowell engines. The D.C. generator supplied current to the central portion of the line while the 5500 volt machines furnished alternating current for the two sub-stations.

The Winnetka sub-station was formerly equipped with two TC 4-125-750, 600 volt rotary converters, and the North Chicago sub-station with one unit of the same size. Each of the three direct current feeding points was furnished with a storage battery floating upon the line without boosters.

The increase in traffic has rendered a higher schedule speed and a shorter headway necessary, so the management of this road is now making provision for this. Within the past year a number of four-motor GE-57 equipments have been purchased, while all of the present two-motor are being changed for four-motor equipments. The cars will be geared for a higher maximum speed and the schedule speed will be correspondingly increased. The headway will also be reduced from 20 to 10 minutes.

To provide for the increased demand for power the generating station equipment has been supplemented by the installation of an ATB 24-540-125, 5500 volt generator and an MP 8-300-125, 600 volt generator, one of the 250 Kw. alternators originally installed being removed. A 500 Kw. rotary converter will be added to the equipment of the Winnetka sub-station and a 300 Kw. rotary converter to the equipment of the North Chicago sub-station. The storage batteries at each point will be added to and their effectiveness increased by the use of boosters. The seven-mile branch now being built west to Libertyville will be supplied with current from a 300 Kw. rotary converter located in a sub-station near its terminus.

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## LIGHTING

### MERIDIAN LAMPS

The Boston & Maine R. R. Co. recently gave us an order for 50 Meridian Lamps for use in the Y. M. C. A. Building, Deerfield, Mass.

The Lewiston & Auburn Electric Light Company, Auburn, Me., recently bought 200 Meridian Lamps for installation in the Lewiston City Hall. This hall was formerly lighted by a large gas chandelier in the center. The ceiling has now been arranged in panels and each panel contains a fixture with Meridian lamps.

The Edison Electric Illuminating Company of Boston, has taken up Meridian lamps with considerable energy, and is making 15 or 20 installations. This company has adopted the policy of free renewals, and intends to make a special effort to push the new lamp.

One interesting installation is at the Wheeler Pharmacy, Boston. The store is 16 ft. x 21 ft., with three windows. It was formerly lighted by five fixtures, each containing two Welsbach lights, with three 16 c. p. incandescents in each window and one in the doorway outside, making a total of ten Welsbach and ten 16 c. p. incandescents. The store is now lighted with five 120 watt Meridian lamps, and the three windows contain one, two and three Meridian lamps respectively. One Meridian lamp is installed outside so that the entire pharmacy is now lighted with twelve Meridian lamps. The proprietor is very much pleased, and says that the illumination is 100% better than ever before. So far as can be determined from the bills for the last two months, the current for the new installation will cost about 10% less than heretofore.

The banquet room of the Hotel Brunswick is now lighted with thirty Meridian lamps, installed in receptacles on the ceiling. The effect is very pleasing and very satisfactory to the hotel people.

The smaller size of Meridian lamp known as Meridian lamp No. 1 is now ready. This lamp consumes 60 watts and gives 25 c.p. downward illumination. It is made up in 3¾″ bulb and is similar in all respects to the present Meridian lamp which is known as the No. 2. We believe this No. 1 Meridian lamp will be especially popular because it consumes about the same current as the ordinary 16 c p. lamp with considerable increase in effective candle-power.

The Meridian lamp immediately attracts attention whenever shown, and numbers of central stations can hardly get the lamps fast enough to supply the demands of their customers.

At the prices quoted on Meridian lamps on April 1st, the cost of renewals per Kw.-hour is no greater than for the ordinary 16 c.p., 3.1 watt incandescent lamp. As a result many central stations are supplying the Meridian lamp on the free renewal basis. This step could be advantageously taken by all central stations now supplying free renewals of the ordinary incandescent lamps.

Central stations will derive material benefit by promoting the liberal use of this lamp. Its simplicity recommends it, and its efficiency is as high as that of any other electric illuminant in use today excepting the arc.

Over 20,000 Meridian lamps have already been sold.

### MARINE SETS FOR FALL RIVER LINE

**The Fore River Ship & Engine Company, Quincy, Mass.**, is building two new steamships for the Old Colony Steamboat Company, to be used in the Fall River Line service, one passenger and one freight, and have placed order with us for four MP 6-50-400, 125 volt tandem-compound marine sets with switchboard equipment. This order was placed with us not only because of the perfect satisfaction given by our sets previously installed, but also on account of the small space occupied per kilowatt output.

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## CENTRAL STATION NOTES

**The Detroit Edison Company** is constructing a new power house in Delray Village about four miles from the center of the City of Detroit.

This power house will furnish power to the Edison Illuminating Company, and the Peninsular Electric Light Company of Detroit. The former supplies the central or business district of Detroit with direct current on the Edison 3-wire system, while the latter furnishes 60 cycle alternating current to the outlying districts. Besides the supply of current to the two lighting companies, it is expected that the new company will supply 3-phase power in large blocks to a number of the industries now located in Detroit.

The equipment which the G. E. Co. will furnish for the new power house will consist of four ATB 12, 3000 Kw., 6000 R.P.M., Curtis turbo-alternators, with two MP 4, 50 Kw., motor-driven exciters. As a reserve for the exciting circuit, there will be an 83-cell chloride storage battery. Current will be distributed by underground mains and overhead lines at 4400 volts, and no transformation will be required except for a limited amount of current sent out at 2200 volts to scattered transformers in the residence districts.

There will be four sub-stations, having G.E. motor-generators, transforming 3-phase, 4400 volts to 240 volts direct current. Each of these sub-stations will be equipped with a standard 1000 Kw. 2-unit machine and a small motor-generator set for balancing the system. The smaller sets used for balancing the 3-wire system are 3-unit machines; each of the direct current generators being 200 Kw. capacity at 120 volts and driven by 600 H.P., Form K motors.

A storage battery is already in commission having a discharge rate of 10,000 amperes for one hour, and two transformer stations in the residence district where current going out at 2200 volts is stepped down and regulated according to the requirements of each feeder. The step-down transformers in each station are three 300 Kw. G.E. air-blast type. Each transformer is equipped with regulating switch and an additional secondary winding of 230 volts in ten steps of 23 volts each.

All high tension circuits from generating station to sub-stations will be operated, both in generating and sub-stations by Type H motor-operated oil switches, and to control these circuits we are furnishing twenty-two 300 ampere, two 500 ampere and three 1200 ampere, 4600 volt switches.

It is expected that the first turbo-alternator will be running early in November and that the entire plant will be completed in 1904.

**The Gloucester Electric Company, of Gloucester, Mass.**, has ordered from us a 16-panel switchboard for control of one 500 Kw., 2300 volt turbo-generator now on order and one 200 Kw. and one 150 Kw. generators now in use.

The switchboard consists of:
Two exciter panels.
One motor panel.
Four generator panels.
Five lighting panels.
One power panel.
One totality panel.
Two transformer panels.

Contract for this board was awarded to us after severe competition and wholly upon the merits of our appliances and workmanship.

**The Municipal Plant of the Town of Hudson, Mass.**, is displacing its 125 cycle apparatus by 60 cycle apparatus, and has ordered from us one ATB 36-250-200, 2300 volt, engine-driven generator, and four-panel switchboard.

**The United Electric Light Company of Springfield, Mass.**, has just ordered another No. 12 Brush arc generator, making a total of fourteen of these generators now operated by this company.

**The City of Taunton, Mass.**, has built an entirely new central station, and ordered from us two ATB 48-400-150, 2300 volt units.

With this apparatus we are furnishing a thirteen-panel switchboard, consisting of:
Two exciter panels.
One regulator panel.
Two generator panels.
Eight feeder panels.

The above displaces all the old 125 cycle apparatus.

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**The Edison Electric Illuminating Company, Boston, Mass.**, is making preparations to shut down the local operating stations in the outside plants, recently acquired, and substitute for the machinery there, transformers and transforming devices, by means of which current will be taken from the large station now building in South Boston.

It is expected that some of these stations will be changed over before October 1st, next, and connected with the L Street Station of the Edison Company in Boston.

The Edison Company has recently ordered from us :—

Seven 500 Kw. air-blast transformers, with four blower sets.

Six 100 Kw. Type H transformers.

Four 300 Kw. air-blast transformers, with two 35″ blower sets.

Three 200 Kw. oil-cooled transformers.

Three 250 Kw. oil-cooled transformers.

Four constant current transformers for operating arc lighting.

**The Leominster Electric Light and Power Company, Leominster, Mass.**, has ordered one ATB 12-200-600, 1150 volt compensated generator, a duplicate of the machine purchased a year ago.

**The Penacook Electric Light Company, Penacook, N. H.**, has ordered one ATB 8-100-900, 2300 volt generator, and the L. A. Crossett Co., North Abington, Mass., one ATB 12-200-600, 600 volt generator, both of the compensated type.

**Whitman Light & Power Company, Whitman, Mass.**, has recently been transferred to Stone & Webster by Mr. John R. Graham, the recent owner. The property was formerly owned by the General Electric Company, but the whole issue of stock was sold to Mr. Graham some five years ago and has since been managed by Mr. C. N. Mason of the Boston Office, acting in behalf of Mr. Graham as Treasurer.

Stone & Webster have now acquired this property to run in conjunction with the Edison Company in Brockton, which is also owned and managed by them. It is not yet decided whether the two stations will be consolidated or not.

## ELECTRIC APPARATUS IN THE RECENT FLOODS

### Kansas City

During the recent floods at Kansas City all electric service both lighting and railway was suspended, as the various power houses were flooded. The actual damage to the property of the lighting and railway companies was, however, much less than was originally supposed. The old railway power house and the new electric light company's power house located on opposite sides of the Kaw river were in the most severely flooded district, but prompt action after the floods subsided soon put the machinery into active use. The General Electric Company's representatives assisted in every possible way in restoring the service. One of them who visited the scene of the flood, reports in part as follows:

The water in the lighting company's power house rose 5½ feet above the engine room floor and 1½ feet above the engine shafts of the two 1500 Kw., 6600 volt units. The mud deposit on the engine bearings and on the stationary armatures and revolving fields of generators had to be dug away with shovels. Only the tops of the pumps and induction motors connected to them were visible above the mud in the basement. The water came up to the lower row of switchboard instruments. After shovelling away the mud from the generators and engines and apparatus on the engine room floor, the fire hose was turned on and the balance of the mud washed off with water. The water was then blown off from the fields and armatures of generatures with compressed air and the bearings were flushed out with several barrels of kerosene oil. This seemed to take the mud away very nicely and the engines were then started up at half speed. The armature short-circuited through the ammeter and the field excited with a low voltage. It is estimated that it would take about two weeks to clean up the oil switches and steam auxiliaries of the power house. Many of the switchboard instruments will be calibrated and repaired on the spot while others will be returned to the Chicago Office repair shop. All station auxiliaries were thoroughly water soaked and covered with mud.

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The Kaw River railway power house was submerged even more than the lighting power house, and it was thought at one time that the building and smokestack foundations had been seriously injured. This, however, did not prove to be the case, and the boilers were gradually steamed up and the generators started slowly with salamanders located in different parts of the power house and in the generator pits for nearly a week.

**Des Moines**

The water during the recent flood rose in the power house of the Des Moines City Ry. Co. two feet above the engine room floor, soaking for thirty hours both 1000 Kw., 575 volt railway generators nearly up to the engine shaft. A 200-foot smokestack, a battery of new boilers and other improvements were in progress at the power house, and the excavations prevented the construction of a temporary dyke or wall around the power house or the engine which would have protected the machines. Our representative was on the ground soon after the flood and assisted in drying out the machines. As soon as the water was pumped out of the pits, steam radiators were put in the generator pits and salamanders placed near the generators on the engine room floor. The engines were run at half speed for one or two days until the generators seemed to be perfectly dry on the surface. Then the armatures were short-circuited with full load current through the switchboard ammeter, the shunt fields being separately excited from an 80 volt generator, and reversed with reference to the series field. The field coils were so saturated with water that they acted like water rheostats, and as much as five times the normal current was applied before they were warmed up. As the water was driven out from them the resistance increased and the full current was gradually reduced. After running for a few days with full load current on the armature, the current was increased to 50% overload or to about 2500 amperes. This warmed up the armature very well but the commutators of these machines ran so remarkably cool that even this current did not heat them sufficiently to drive out the moisture that had soaked in. Salamanders were placed in the generator pits and sheets of asbestos used as deflectors to throw the heat from the salamander on to the iron ring of the commutator spider, also to protect the engine eccentric, the brush-holder rigging and commutator from the heat. This scheme proved very effective. Every other bolt was taken out of the commutator clamping flange in order to allow the moisture and steam to pass out through the bolt holes.

At the present writing practically all of the machinery has been put in running condition again. The flood experience illustrates in a striking manner the durability of General Electric apparatus, and should prove a strong argument in securing business. Instances where apparatus of other design has been entirely ruined by being subjected to similar conditions are doubtless familiar to our agents.

**HEAVY TURBINE SHIPMENT**

The largest piece of apparatus ever shipped by the General Electric Company was recently consigned to the Chicago Edison Company. This was the armature of an ATB 6-5000-500, 9000 volt generator, direct connected to a 5000 Kw. two-stage Curtis turbine.

The weight of the armature alone was 124,000 pounds.

To make this shipment it was necessary to secure the consent of the officials of the N. Y. C. & H. R. R.R., and pay a bonus of 50 cents a mile in addition to the regular rate.

Steel sheathing was used for protection against the weather, instead of the ordinary wooden sheathing, in order to secure sufficient clearance in bridges.

A special train was made up, consisting of an engine and the necessary cars for transporting the set.

We have ordered from the American Car & Foundry Co., two steel cars having over-all dimensions of 40 ft. 7 ins. in length and a height of 3 ft. 2 ins., with a carrying capacity of 130,000 pounds, especially designed to meet the requirements of such heavy shipments

It is expected that these cars will be ready for use in the near future.

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## POWER TRANSMISSION

### COLUMBIA IMPROVEMENT COMPANY
**Puyallup River Development**

Through negotiations with Messrs. Stone & Webster contracts have recently been closed for the electrical equipment of the largest water power transmission on the Pacific Coast. The order includes 21,000 Kw. in generator capacity and 35,000 Kw. in transformers, the largest order for transformers ever closed.

The power is derived from the Puyallup River, which has its origin in a glacier of Mount Ranier, State of Washington, and flows northwest, entering Puget Sound near Tacoma. A dam is thrown across the river and the water diverted and carried by flume and ditch 10¼ miles to a forebay from which steel pipes lead to the power house. The net head on the wheels is 850 feet.

The principal contracts are with the Columbia Improvement Company and call for:

Six ATB 3500A–225, 2300 volt generators for direct connection to impulse water wheels.

Nine WC 2333Kw.–2300–55000 step-up transformers with taps on high voltage winding for 45,000 and 27,500 volts.

Two exciter sets, each consisting of a 150 Kw. exciter direct connected to a 2080 volt induction motor, and to a water wheel, either source of power being of sufficient capacity to give the full output of the exciter, and a switchboard arranged according to the best modern practice.

Accessory contracts have been closed with the Seattle Electric Company for four 2000 Kw. step-down transformers arranged to transform from the three-phase transmission line potential to 2300 volts two-phase, and with the Tacoma Railway & Power Company for three more transformers, duplicates of those described.

A 50 Kw. high potential testing set, giving a varying voltage up to a maximum of 160,000 volts, is being provided for testing insulators and completed sections of line.

### POWER TRANSMISSION PLANT FOR GLUCOSE FACTORY

The Granite City Manufacturing Company of Granite City, Ill., located just across the river from St. Louis, is building a large glucose factory. This plant, which will be the most modern of its kind, is being built by local capital to compete with the Glucose Trust.

After careful investigation the corporation closed a contract with the General Electric Company for the electrical apparatus, including the following:

One 3-phase direct connected revolving field alternator, 800 Kw., 100 R.P.M., 25 cycle, 600 volt, engine-driven type.

One 3-phase direct connected revolving field alternator, 200 Kw., 125 R.P.M., 25 cycle, 600 volt, engine-driven type.

With the above generators there will be furnished marine-engine-driven type exciters.

This contract also covers twenty-six standard 25 cycle, 550 volt, Form K induction motors, with oil compensators.

Also six 60 H.P., special vertical shaft, 3-phase induction motors for operating burr mills.

In addition to the above, the General Electric Company will also furnish a complete switchboard.

It may be of interest to note that our competitors recommended 440 volt apparatus for this installation but were willing on a final issue to agree to build 600 volt apparatus.

### ACME BOX AND SHOOK CO.,
**Covington, Ky.**

This Company has recently placed an order with the General Electric Company for about 125 H.P. in induction motors for operating a new box and shook factory, which they will soon put in operation at Covington, Ky.

Each machine is to be operated by an independent motor. The motors are all three-phase, 60 cycle, 220 volt machines, varying in size from 5 H.P. to 20 H.P., and will be started by means of triple-pole double-throw switches and taps brought out from the transformers.

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### THE PUEBLO & SUBURBAN TRACTION AND LIGHTING CO.

The Pikes Peak Power Company which has recently been consolidated with the Pueblo & Suburban Traction & Lighting Company, is located eight miles east of Victor, Colo., on East Beaver Creek, a small mountain stream fed from the snows on the southern slope of Pikes Peak.

The dam and reservoir are located about five miles above the power house, the water being carried in pipes to the water wheels. The dam is a steel faced, granite back, filled structure, 450 ft. long, 90 ft. high, and 160 ft. thick at the base. The upper steel face is built up of sheet steel 5 x 15 ft., and is ½" thick at the bottom, tapering to ¼" at the top of the dam. The plates are held together by means of expansion joints and are firmly anchored to railroad irons imbedded in the granite. The reservoir has a surface area of 140 acres, and holds sufficient water to operate the plant for two or three months.

The pipe line is 36,100 feet long, and has an inside diameter of 30 inches. A length of 23,200 feet of this pipe line is made of 1½" redwood staves, banded together with ½" steel bands, spaced 2¼" to 8" apart. The remaining 2900 feet is made of ¼" to ¾" steel pipe 29" in diameter. The pipe line is provided with a "riser" to prevent excessive pressure in case the valves should be suddenly closed. The effective head is 1160 feet, giving a pressure of 500 pounds per square inch at the nozzle.

The power house is a fireproof building 38 x 100 feet, with two wings 16 x 48 feet. It is located at the bottom of a cañon 1100 feet deep and the only means of access is by a cable road 3500 feet long with a maximum grade of 60%. The car is operated by means of a hoisting engine located at the top of the road.

The electrical equipment consists of four 375 Kw., 30 cycle, 600 volt, three-phase generators and two 200 Kw., 60 cycle, 600 volt, three-phase generators (direct connected to Pelton water wheels) and six air-blast step-up transformers. There are two 30 Kw. water wheel driven exciters, each being of sufficient capacity to excite all the generators.

The 30 and 60 cycle current is stepped up to 12,600 volts, and transmitted over the same pole line to Victor where it is distributed throughout the Cripple Creek mining district, the 30 cycle current being used for power and the 60 cycle current for lighting.

The four-wire secondary system of distribution is used for lighting, the neutral being obtained in the usual manner from the Y-connected transformers. The power load (with the exception of one 120 Kw. rotary converter which is used for supplying direct current to locomotives in one of the mines) consists entirely of induction motors which are used for hoisting and for various other purposes in the different mines. The poles for the lines to Victor are cedar, 35 to 50 feet high and set 120 feet apart. The cross-arms are yellow pine, 4" x 6", and the pins are locust 1½" in diameter. Neither the poles nor the cross-arms are treated. The insulators are three-part triple-petticoat porcelain, 6" in diameter, and are tested at 40,000 volts under salt spray.

The 30 cycle circuit is composed of three No. 4 wires strung 36" apart at the points of an equilateral triangle. Each circuit is transposed every one-half mile, making a complete turn in each one and one-half mile.

The telephone line is on the same poles four feet below the three-phase circuits. It is transposed every 120 feet or at every pole.

Until the consolidation with the Pueblo & Suburban Traction & Lighting Co., the Pikes Peak Power Co. supplied lights and power only to Victor and the Cripple Creek mining district; but recently two 300 Kw., 30 cycle rotary converters and two 300 Kw., 60 cycle synchronous motor-generator sets with transformers have been purchased for operating the street railway and lights in the city of Pueblo.

Power for three rotaries and motor-generator sets will be transmitted at 40,000 volts and stepped down to 345 volts for the rotaries, and 2300 volts for the synchronous motors. The four-wire secondary system will

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be used for lighting, the neutral being obtained from the transformers.

The pole line to Pueblo, which is 39 miles long, will be practically the same as the line to Victor. Three-part glass insulators, 11″ in diameter, with iron pins will be used. There will be two circuits of No. 4 copper wire, and the switchboard will be arranged with double-throw switches, so that either line may be operated singly or both in parallel.

There are at present installed in the steam plant at Pueblo one 500 Kw., one 250 Kw., and one 150 Kw., 60 cycle, 2300 volts, single-phase generators, which are used for lighting purposes. It is proposed to rewind these generators for three-phase and operate them in parallel with the motor-generator sets above mentioned.

There are also installed in this station two 110 Kw. and two 225 Kw., 550 volt railway generators, which are at present supplying power to the street railway, but these will soon be replaced by rotary converters.

It is further proposed to install two more hydraulic plants four miles below the present station, and all three (the aggregate capacity of which will be 10,000 H.P.) will be operated in parallel and the power transmitted over the present pole lines to Victor and Pueblo.

### NEW MILFORD POWER COMPANY, New Milford, Conn.

Water power from the Housatonic River near Merwinsville, Conn., is soon to be utilized to the extent of 6000 Kw. in generator capacity by the New Milford Power Company. The power is stepped up from 1150 to 33,500 volts for transmission to the three principal sub-stations of the Connecticut Railway & Lighting Co.; a total of about 16,000 Kw. in step-up and step-down transformers being used. The original contract closed about a year ago calls for five ATB 18-1000-400, 1150 volt generators for direct connection to water wheels, and seven WC 60-850Kw., 1150-33500 volt step-up transformers with the necessary exciters and controlling switchboard; also nine AB 60-500Kw., 33,000-2300 volt step-down transformers for installation in Waterbury sub-station No. 1 from which 2300 volt feeders will supply power to Waterbury sub-station No. 2 for arc lighting from constant current transformers and direct current three-wire service from four 300 Kw. rotary converters.

An additional order has recently been placed for another 1000 Kw. generator to be installed in the same power station, and four ABH 60-550Kw., 33000-430 volt transformers for operating rotary converters in Waterbury sub-station No. 1 located 26 miles from the power station. From Waterbury sub-station No. 1 the line extends a further distance of 18 miles to New Britain and Cheshire sub-stations, in each of which there are to be installed three ABH 60-330Kw., 33000-430 volt transformers, also for the operation of rotary converters. There are also being provided for New Britain two 500 Kw. transformers, 2300 volts secondary — duplicates of those for Waterbury sub-station No. 1.

All the above apparatus is 60 cycle, and the 5000 Kw. of rotary converters will form the largest 60 cycle converter plant yet installed.

### CHARLES A. CHAPIN WATER POWER PLANT, Buchanan, Mich.

This transmission plant, which has recently been started, comprises:

An ATB 40-1500A-180, 2300 volt, DS-2 generator.

One MP 6-60-300, DS-2, 125 volt exciter.

Three WC 60-500-2300-25300-43800Y step-up transformers, together with generator, exciter, transformer and line panels, lightning arresters, etc.

The generator is direct connected to a line of shafting to which ten 68″ Samson turbines are geared. The voltage is stepped up to 25,000, the transformers being arranged for Y connection at 40,000 volts, which voltage it is intended to use later when the capacity of the plant is increased, to avoid the necessity of putting up additional copper.

It is intended later on to install two 750 Kw. machines, making the total capacity of the plant 3000 Kw.

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At present a circuit runs to South Bend, Indiana, sixteen miles distant, at which point the sub-station is located in the old steam power house of the South Bend Electric Co.

The sub-station apparatus includes three WC 60-500-24500-42500-2300-320Y transformers and one TC 8-300-900, 550 volt converter. The 320 volt tap on the transformers is for operating the converter. The primaries are provided with taps for 23,500 and 22,500 volts.

The converter has its shaft extended for a flange coupling so that it may be coupled to a section of shafting with pulley for belt driving. This arrangement provides for operating the converter as either a direct current or three-phase generator from the steam plant in emergency.

The secondary 2300 volt distribution is carried through the city, supplying small induction motors and lights. Recently an order has been placed by the South Bend Electric Co. for an I 12-100-600-L, 2080 volt, three-phase induction motor for operating a pump at the city water works.

A very good description of the power house of the South Bend Electric Co. is contained in *Steam Engineering*, June 10, 1903. There is also an article in the *Electrical World and Engineer* for May 30, 1903, describing this development.

## POWER APPLICATIONS

### PROXIMITY MANUFACTURING COMPANY, Greensboro, N. C.

We have completed the installation at the White Oak Mills of one ATB 48-250-100, 600 volt, engine-driven generator with necessary auxiliary apparatus including switchboard, which furnishes power for three 100 H.P., 550 volt, Form L induction motors used in driving the machinery of the weave room. Before the electrical installation, the weave room contained 1050 looms driven by belts from the main engine, a Hamilton-Corliss rated at 750 H.P., but ordinarily operated at about 900 H.P. of which amount 335 H.P. was used in the weave room, as shown by the indicator cards. On changing from the mechanical to the electrical drive, the total number of looms was increased to 1150, or by about 10%, the speed being also increased from 160 to 168, or by about 5%. The maximum current required was 225 amperes, which at 600 volts shows an apparent power consumption of 233.5 Kw., or 207 Kw. at 89 % power factor—equivalent to 278 H.P. output at the generator. Assuming 92.5% efficiency for the generator, the actual power exerted at the engine shaft would be 301 H.P., and if we assume a 10% loss in the engine, it would appear that the total power required for the electrical drive is 330 H.P. against 335 for the mechanical. This proves conclusively that the operator is getting 15% greater output with the electrical drive than with the mechanical, and at a somewhat less input.

The Mill Superintendent states that the looms operate at a much more regular speed than formerly, and that the waste is also considerably less, especially on the draper looms.

In view of these very satisfactory results which have been obtained from this installation, and the cordial relations established with the Proximity people thereby, we have recently closed contract with them for their Proximity Mills, also at Greensboro, for the following 40 cycle apparatus:

Two ATB 64-1250-75, 600 volt generators for direct connection to engine, with one 50 Kw, engine-driven, and one 50 Kw. motor-driven exciter sets, one 10 panel switchboard, three 133 Kw. transformers with 115 volt secondaries for lighting, and 550 volt, Form L induction motors aggregating in capacity about 3000 H.P.

### INTERNATIONAL PAPER COMPANY, Palmer Falls, N. Y.

The above company is building a new mill not favorably situated for direct driving from water power.

We have closed a contract for one ATB 12-1000-400, 600 volt dynamo, with

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direct connected exciter for coupling to water wheel, one complete switchboard, and three 250 H.P., 480 R.P.M., 550 volt, Form K motors.

### THE WHITIN MACHINE WORKS,
**Whitinsville, Mass.**

This company now has in use about 1000 Kw. in 40 cycle, 600 volt, three-phase generators of our make. They manufacture textile machinery, and use our motors throughout. We have just shipped a 150 H.P. induction motor which will be belted to an air compressor. This air compressor will operate a sand blast for cleaning castings, in place of cleaning them by hand with acid as in the past.

### LARGE ELECTRICALLY OPERATED ORGAN

We have on order a CE 4-7.5-815, 230 volt motor to be used on the high pressure portion of a new organ to be installed by Hutchings-Votey Organ Company, Boston, Mass., in Woolsey Hall, Yale University, New Haven, Conn. This will be the largest organ in this country and is unique in that it is operated throughout by electricity.

### GENERATORS AND MOTORS FOR SHOE FACTORIES

Shoe manufacturers are availing themselves of electric drive as evidenced by these recent orders:

Geo. E. Keith Co., Brockton, Mass., have for some time been using approximately 150 H.P. capacity in induction motors driven from 150 Kw., 600 volt, three-phase generator. They have recently exchanged this generator for an ATB 16-300-450, and have placed a supplementary order for three 10 H.P., three 15 H.P. and one 30 H.P. induction motors, making a total of 275 H.P. in motors and 1800 lights now in use.

L. A. Crossett Co., North Abington, Mass., has ordered an ATB 12-200-600, 600 volt compensated generator for power and light. The equipment will include two 10 H.P., four 15 H.P., one 20 H.P. and one 30 H.P. induction motors.

### PRINTING PRESS MOTORS

**Forbes Lithograph Manufacturing Company, Chelsea, Mass.**

One 15 H.P. and two 5 H.P. printing press motor equipments for special lithograph presses have been furnished to the Forbes Company. These motors are variable speed, with belt-tightener heads and R-43 controllers. They can be stopped from any point on the press frame by push button circuit. By the additional use of electric fly-wheel brake, the press is stopped without undue shock, with consequent saving in belting and motor wear.

### SOULE MILL,
**New Bedford, Mass.**

About a year ago we installed in the Soule Mill an ATB 32-1300-150, 600 volt generator, direct connected to a vertical McIntosh & Seymour engine and about 2000 H.P. capacity of 550 volt induction motors.

This equipment has been so satisfactory that they have recently placed an order with us for additional equipment consisting of a 900 Kw. generator of similar type, together with 1075 H.P. additional in motors. This latter equipment is to be used in a recent addition to the original mill.

This mill is located on land that would not have been available for a mill of this kind, had it not been equipped electrically—another argument strongly in favor of electric drive.

We have in mind a similar installation on a somewhat larger scale where the engineers estimated that the saving in the cost of foundations and buildings was considerably larger than the entire cost of the electrical equipment by which the mills were driven.

### STUDEBAKER BROS. MANUFACTURING CO.,
**South Bend, Ind.**

The electrical equipment of this plant includes the following apparatus, which was started up in January:

One ATB 72-400-B-100, 480 volt generator, one MP 4-20-450, 125 volt, belt-driven exciter, one generator panel, one exciter panel, four feeder panels, thirty-seven 60 cycle, Form K induction motors from 1 to

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50 H.P. and three ATB 6-40Kw.-1200-55 H.P., 440 volt, 60 cycle synchronous motors.

The generator is direct connected to an Allis-Corliss engine of 750 H.P. capacity. The unit replaces two engines formerly operating from the same battery of boilers aggregating 1000 H.P. capacity.

This plant was installed to give the purchaser an opportunity of determining the relative economy and advantages of electric drive over belts and shafting, and embraces only the wagon department of the immense factory of Studebaker Bros., which is the largest of its kind in the world. The wagon shop alone turns out 600 wagons per week.

Most of the motors are belted to short lines of shafting, the sizes so applied ranging from 3 H.P. to 50 H.P. The shafting driven by the 3 H.P. motor operates some drills and a box-ironing machine.

A 30 H.P., 900 revolution motor is direct connected to a gang and rip saw.

Two 40 H.P., 900 revolution motors, and one 50 H.P., 720 revolution motor, are direct connected to planers and matchers.

Two 20 H.P., 900 revolution motors are direct connected to exhaust fans.

One 20 H.P., to a positive blower.

The three 55 H.P. synchronous, 440 volt motors are direct connected to 70″ fans for operating the blower system, to take care of the shavings, which are deposited at the boilers, mixed with coal dust and used as fuel.

The synchronous motors are provided with starting compensators and are not required to start under load, as the drafts on the fans are closed at the time of starting. The load on the generator varies from 420 to 600 Kw., the latter representing the maximum fluctuation when planers are started. It is found that the material on which they are working has considerable effect on the maximum load.

Up to the present time no accurate tests have been made, but it has been found that the fuel bills are reduced, notwithstanding the fact that they are operating about 100 H.P. more in machines than before the change. In making the change, the speed of the line shafting was increased throughout from 200 revolutions to 220 revolutions per minute, so that the output was directly increased. The use of motors has resulted in greater uniformity of speed and in reduced losses between the prime mover and the machines driven.

The three synchronous motors are excited from the generator exciter, notwithstanding that they are located from 800 to 1000 feet distant. A circuit consisting of No. 2 B.&S. wires carries the exciting current. The field rheostat for each motor is located at the motor and the arrangement has been entirely successful. The advantage of avoiding operating three separate exciters for these motors is obvious.

## ELECTRICALLY EQUIPPED BRIDGES IN NEW YORK CITY

The Department of Bridges of New York has adopted specifications for electrically operated bridges based upon standard construction for railway motors.

At the present time 14 bridges have been equipped or contracted for, all operated by G. E. motors.

Most of the swing bridges are equipped with one GE-800 or GE-52 motor, and R-27 controllers.

The Harway Avenue Bridge, which is a counter-balanced lift bridge, is fitted with two CB-14 motors.

The 145th Street Bridge is to be equipped with two GE-58 motors for turning, and one GE-800 motor for the end lifts.

The only current available at this bridge is two-phase 60 cycle A. C. and it was dec ded to install a 20 Kw. motor generator set on the draw, to supply direct current to the motors.

The service will be supplied from transformers on both sides of the river, one circuit taking current from the Harlem Station, and the other from the North River Station, of the New York Edison Company, a double-throw switch being furnished on the draw span so that the current can be taken from either source of supply.

The McCombs Dam Bridge over the

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## TRANSFORMERS

Harlem River is to be equipped with one IQ 12-20HP-600, Form M motor, wound for an extra large starting torque of 700 pounds.

The Vernon Avenue Bridge which is a Sherzer double-rolling lift bridge will be equipped with four GE-57 motors.

In addition to the above city bridges, the Long Island R. R. Company has three swing bridges on its Rockaway Beach Division, each equipped with two GE-800 vertical motors, and the New York, New Haven and Hartford R. R. one bridge at Westchester Creek, also equipped with G. E. motor.

### NOTABLE TRANSFORMER ORDER

We are now building for the Pierce County Improvement Company, Tacoma, Washington, nine 2333 Kw., and seven 2000 Kw. water cooled transformers, making a total of 35,000 Kw. in transformers.

These transformers will contain many interesting features, and merit some detailed consideration. Not only is the total installation large, but the individual units are of unusual size and designed for high voltage operation, viz.: 40,000 to 55,000 volts on the primaries.

The 2333 Kw. transformers are rated:

WC-60-2333-55000-45000-22500-2300.

They are of the well-known General Electric type of water-cooled construction and will be the largest oil insulated transformers in existence.

The generating station at Puyallup River will, at first, contain nine of these units with provisions for the installation of six additional transformers. From the generating station, the current is transmitted to an intermediate distributing station, from which it is sent out for interurban work at Milton, Kent and Georgetown, and for city distribution at Seattle and Tacoma.

The step-down transformers at Seattle and Tacoma are rated WC-60-2000-50000-40000-25000-20000-13800-6900-2300. There will be four at Seattle and three at Tacoma, These will be connected in sets of two each for three-phase to quarter-phase transformation. The usual method of winding transformers for operation in this way is to have both primary windings alike but provided with taps, so that when operating together the teaser transformer will have 87% as many active primary turns as the main transformer. In high voltage designs, it is desirable to have the primary windings simple, and not to complicate them with any more taps than necessary. To avoid bringing out additional leads in this instance, the active primary turns in both main and teaser transformers, when operating in a three- to quarter-phase combination, are identical, and the necessary difference in ratio is obtained by placing a 200 Kw. step-up compensator in the secondary distribution from the teaser transformer. This step-up compensator is so designed that it may be used as a 9 to 1 transformer, that is, 2080 volts may be impressed on the high tension and 200 Kw. taken from the low tension winding at 230 volts, so that if the company decides subsequently to add an additional transformer to each of the pairs of transformers as at first installed, and to use a three-phase distribution, the discarded compensator can still be used.

With the above transformers, will be ordered generators, switchboards and transformers of smaller capacity than those mentioned above, which will probably be described in a later issue as soon as the details are settled.

### AIR BLAST TRANSFORMER PATENT SUSTAINED

The Circuit Court of the United States, Southern District of New York, has recently rendered a decision in favor of the General Electric Company in a suit brought by the General Electric Company against the Wagner Company on the Moody air blast transformer patent.

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## RECORDING WATTMETERS

The United Gas and Electric Company, New York, which operates plants in 13 different cities in various parts of the country, has given us a contract for one year, covering all wattmeters required for the 13 plants.

## MISCELLANEOUS APPARATUS

### SMALL COMBINATION MACHINES FOR COLLEGE OR LABORATORY USE

For several years the General Electric Company has had frequent inquiries from colleges and institutions of similar character for a small alternator suitable for laboratory use. To meet this demand we have designed the ATB 6-7.5-1200, 220 volt, belt-driven generator, which, with a few changes, will give a variety of outputs, usually obtainable only with several machines.

The combination consists of an induction motor field or primary, three induction motor armatures (one Form K, or squirrel cage, one Form L, with internal starting resistance, and one Form M, with collector rings), and a revolving field, so that the machine may be used as a generator, synchronous motor, or induction motor. The stationary member, or primary, is provided with 12 terminals, so that it may be connected either **Y** or △, three-phase, two-phase, six-phase, or single-phase. The Form M induction motor armature is provided with three collector rings, so that it may be connected in either of the different combinations. This machine can be used as follows:

1st. *Induction Motor.*—As an induction motor of about 7.5 H.P. capacity. The primary has the following potentials:

| | |
|---|---|
| Three-phase **Y** . . | 220 volts. |
| " " △ . . | 127 " |
| Two-phase . . . | 190 " |
| Six-phase, per phase | 54 " |
| Single-phase **Y** . . | 285 " |
| " " △ . . | 165 " |

2d. *Frequency Changer.*—With the collector ring armature this machine is a very satisfactory frequency changer, producing a frequency either greater or less than 60 cycles, depending on the direction of rotation of the armature. If the armature is driven at normal speed in the direction opposite that in which it tends to run as a motor, it produces a frequency of 120 cycles, with a potential of about 146 volts between the collector rings.

3d. *Alternating Current Generator.*—If the machine is used with the revolving field it will operate as a polyphase generator with an output of 7.5 Kw. and give the following potentials for the different connections:

| | |
|---|---|
| Three-phase **Y** . . | 380 volts. |
| " " △ . . | 220 " |
| Two-phase . . . | 310 " |

Single-phase, either 380, 220 or 310 volts, depending on whether the coils are connected **Y** or △, or for the two-phase arrangement.

Six-phase potential has 110 volts per phase.

4th. *Synchronous Motor.*—This set with the revolving field will operate as a Synchronous Motor when supplied with the correct voltage for the different connections, as shown in list of connections and voltages under alternating current generator.

The weight of the revolving elements is 165 lbs. each, so that they may be changed by hand in a few minutes. The shields and bearings are split so that the Form M induction motor armature may be changed without removing the collector rings.

The machine is provided with a pulley and mounted on sliding rails. The bearings are supported by shields similar to the standard General Electric induction motors.

These sets have been purchased and are now used in the laboratories of many of the leading colleges throughout the United States.

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# General Electric Company Review, August, 1903

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# GENERAL ELECTRIC COMPANY REVIEW

VOL. I SCHENECTADY, N. Y., AUGUST, 1903 No. 4

GENERAL ELECTRIC COMPANY REVIEW

The REVIEW is published monthly for the information of officers and employees of the General Electric Company only.

MARTIN P. RICE, - - - - - *Editor.*
EDMUND P. WALLER, - - - *Ass't Editor.*
CARYL D. HASKINS, - *Commercial Conferee.*

News items and contributed articles for the issue of any month must reach the Publication Bureau by the twentieth of the preceding month.

Good photographs can be readily reproduced in the REVIEW and frequently add to the value of descriptive articles.

## AUTOMATIC VOLTAGE REGULATORS

In order to give satisfactory electric service where constant potential current is furnished, the current must be supplied at almost constant pressure. A variation in pressure of only one per cent. has a marked effect on the life and candle power of incandescent lamps. An increase in pressure of one per cent. will reduce the normal life of an incandescent lamp about eighteen per cent. and will increase the candle power six per cent. A variation in pressure will also change the speed of direct current motors. From the above it will be seen that it is of the greatest importance to the welfare of a central station that the current be delivered to its customers at a constant voltage. It can be fairly claimed that central station managers operating direct current generators have given the subject of voltage regulation somewhat closer study and are furnishing current at more nearly uniform pressure than is supplied from alternating current stations. This is probably due to the fact that in the large direct current central station operating an Edison three-wire network the loss in pressure at full load from generator to lamp is usually about twenty per cent., while in the alternating plant the loss is about ten per cent. The difference in losses in the various feeders of the average direct current plant necessitates the use of several sets of bus bars operated at different voltages and controlled by pressure wires brought back from the various centers of distribution to the meters at the station.

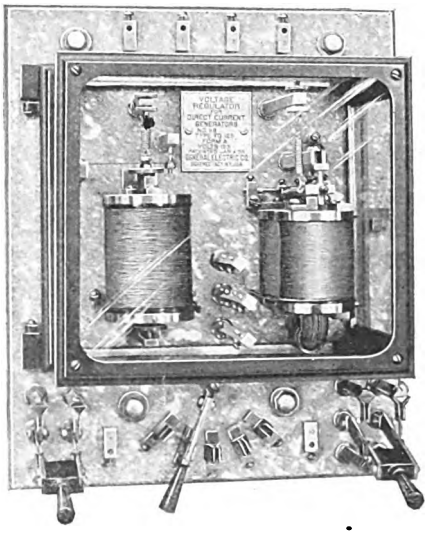

*Fig. 1*
**Type TD Automatic Voltage Regulator for Direct Current Circuits**

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In an isolated plant, such as an office building, the bus bars may be considered the center of distribution, and there is rarely a loss in the feeders of more than three per cent. This close regulation has given such good results that it has been found possible to use high efficiency lamps requiring 3.1 watts per candle power instead of 3.6 watt lamps as formerly used.

In alternating current plants compensating voltmeters are generally used instead of pressure wires, while feeder regulators are used to give the voltage variations required by the different feeders. As a result, the regulation is not as good as in the case of direct current plants, and the majority of alternating plants are still using lamps taking 3.6 watts per candle power. If the customers' circuits were supplied with current of constant pressure the output in incandescent lamps could be increased 13.9% by the use of 3.1 watt lamps.

The object of this article is to call attention to some generator and feeder regulators which are being placed upon the market by the General Electric Company to enable central station managers at small expense to supply their customers with current of uniform pressure, and increase the output of their incandescent service 13.9% without any additional expense other than the cost of regulators and compensating voltmeters. The extensive and growing use of curve drawing instruments has clearly shown the variation of pressure existing on systems, and no central station manager should be without these instruments placed at centers of distribution. But before attempting to regulate the pressure at such points by means of feeder regulators the main source of supply should be maintained at the proper pressure. The generator voltage is maintained at the proper point to overcome the losses of the principal lighting feeder by placing the current transformer, which operates the compensating winding of the regulator, in this feeder. The other circuits should be taken care of by feeder regulators.

The voltage of a generator is greatly affected by the speed and temperature changes. From the above it can be seen that an automatic generator regulator has distinct advantages over any system of compound winding as it is practically independent of temperature and speed changes.

The first type of regulator for generators was the automatic rheostat of Mr. Edison's, which was used with shunt wound direct current generators fifteen years ago. This was used about five years when its manufacture was discontinued in favor of the compound wound machine. The advantage of being free from change in voltage due to change in speed and temperature was not sufficient to overcome the higher cost of the automatic rheostat as compared with a compound wound machine. This type of regulator when used with modern machines is not a success owing to its inability to control the voltage quickly enough. In order to vary the voltage quickly the rheostat arm would have to move a considerable distance instantly and regulators of this type have failed to control the voltage as the service demanded. The compound wound generator does not give proper voltage when its speed is changed and the compound winding does not correct for temperature effects. A generator regulator of novel design has recently been invented by Mr. A. A. Tirrell, and has been placed upon the market by the General Electric Company. Two types have been designed, one to be used with direct current generators, known as Type TD, and the other, Type TA, for alternating current generators. These regulators control the voltage of the generators by closing and opening a shunt circuit across the field rheostat, thus cutting in and out the resistance in the field circuit of the generator in direct current machines and the exciter in alternating current machines — the voltage being varied by the length of time the resistance is in or out of the circuit. The contacts which cut in and out the resistance operate from 50 to 800 times per minute, the movement of the contacts being about one thirty-second of an inch.

### Direct Current Regulators

Fig. 1 shows the direct current regulator. The magnet on the left is the control magnet

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which is connected across the circuit to be regulated. A relay is located at the right; the movement of the contacts of the control magnet causes the relay contacts to open and close. The contacts are connected to the terminals of the field rheostat of the generator, so that when the relay contacts are closed the field rheostat is short circuited and the generator tends to give its highest voltage.

When the relay contacts are open all the resistance of the field rheostat is inserted in

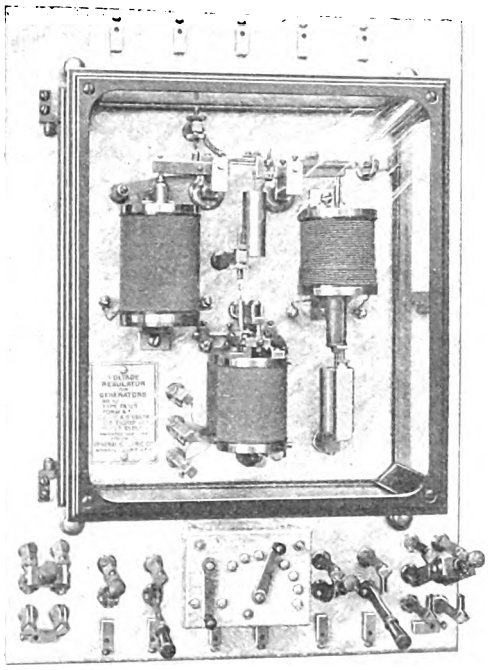

*Fig. 2*

**Type TA Automatic Voltage Regulator for Alternating Current Circuits**

the field circuit of the generator and the generator then tends to give its lowest voltage. Therefore by rapidly closing and opening the relay contacts the voltage of the generator is maintained at the desired value. A condenser is connected across the relay contacts to prevent injurious sparking. The control magnet is connected by means of pressure wires to the center of distribution. The largest single generator that can be controlled by a Type TD regulator is approximately 150 Kw. Several compound wound generators may be operated in parallel and controlled by a TD regulator operating in the field circuit of any one of the several generators.

**Regulator for Alternating Current Generators**

The voltage of the alternating current generator is controlled by varying the resistance in the field of the exciter.

The regulator for the A. C. generator is similar to the D. C. regulator with the addition of another control magnet which is connected across the exciter circuit. Fig. 2 shows the regulator for A. C. generators. The magnet on the left is the D. C. control magnet which is connected across the exciter circuit; the magnet on the right is the A. C. control magnet which is connected across the circuit to be regulated, while the relay is in the center. The alternating control magnet has two windings, one which is connected across the circuit to be regulated, the other which is connected to a series transformer. The function of the second winding is to build up the generator voltage in direct proportion to the current in the line and thus compensate for the loss in the line. The compounding effect can be varied by means of two levers swinging over contact points which cut in or out various turns on the magnet. Once the regulator is adjusted it will maintain constant potential at a center of distribution, without any hand adjustment, irrespective of the character of the load. The regulation is not affected by speed changes unless the speed is so low that the voltage could not possibly be maintained. The A. C. and D. C. control magnets together operate a pair of contacts known as floating contacts which operate the relay magnet which in turn opens and closes the shunt circuit across the exciter field rheostat as in the D. C. regulator described above. The function of the floating contacts is to so actuate the relay magnet that a steady voltage is maintained under all conditions of exciter and alternator voltages. These contacts bring together the A. C. and D. C. portion of the regulator and control the voltage of both simultaneously. These contacts will usually rise from no load to full load about 3-32 of an inch, while the exciter

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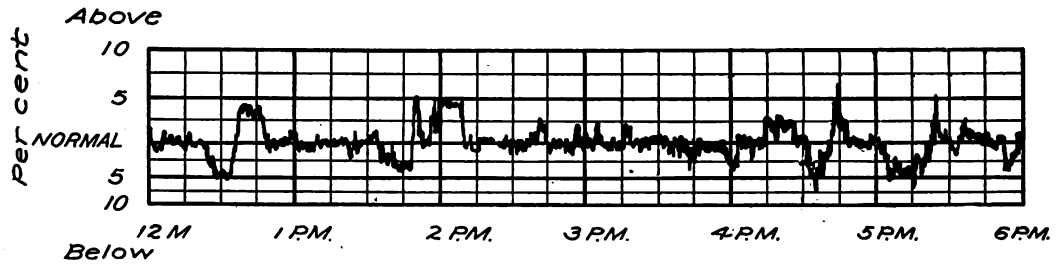


*Fig. 3*
Curve Showing Variation of Speed (Without Regulator)

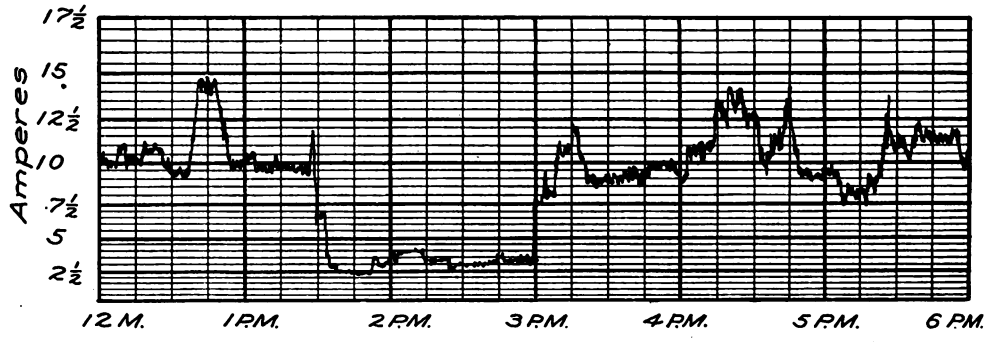


*Fig. 4*
Curve Showing Variation of Load (Without Regulator)

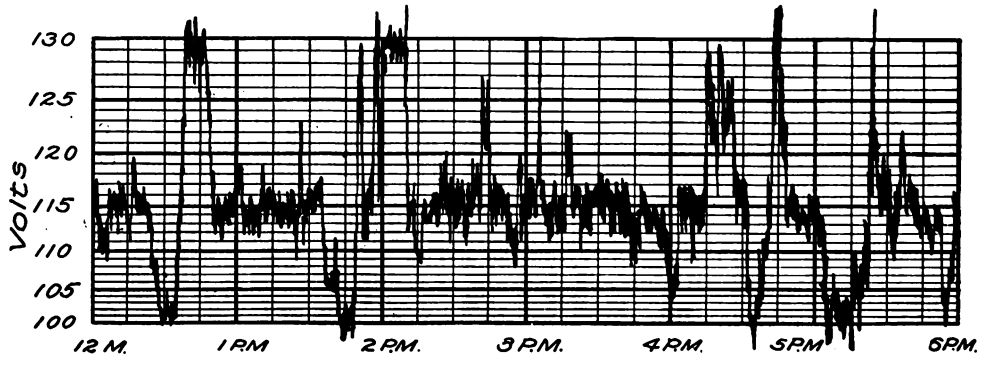


*Fig. 5*
Curve Showing Variation of Voltage (Without Regulator)

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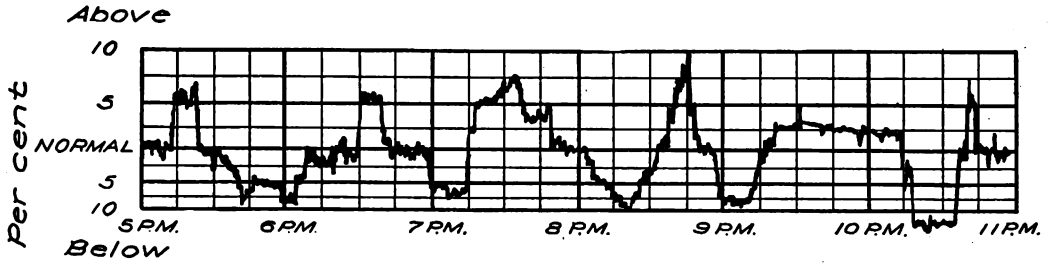


*Fig. 6*
Curve Showing Variation of Speed (With Regulator)

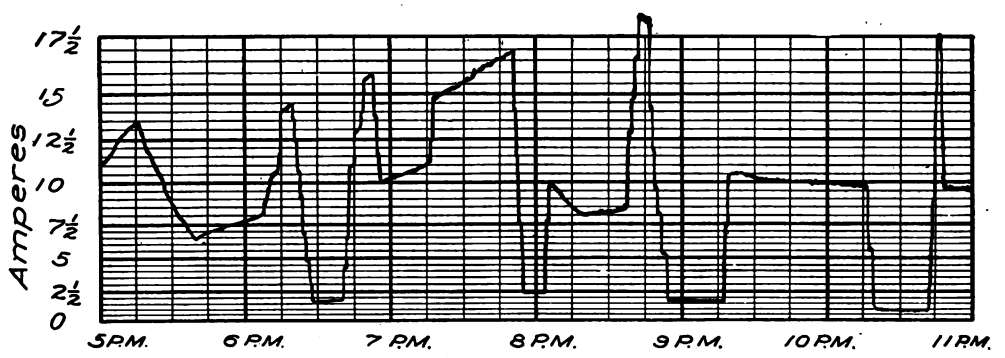


*Fig. 7*
Curve Showing Variation of Load (With Regulator)

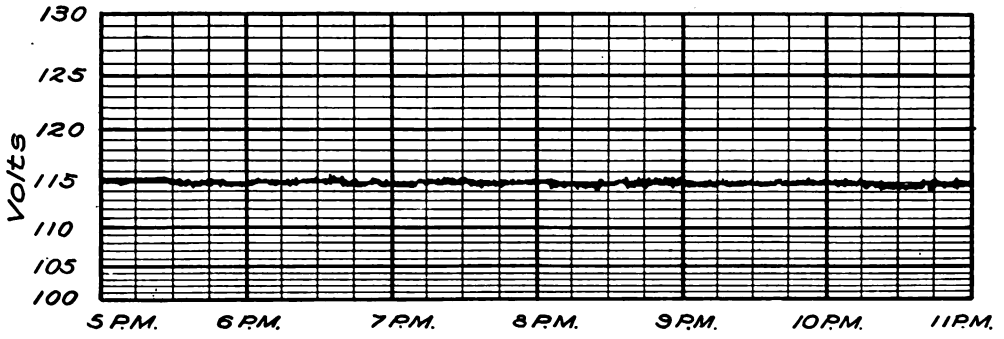


*Fig. 8*
Curve Showing Variation of Voltage (With Regulator)

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voltage may vary from 70 to 125 volts in order to maintain the desired alternating voltage at center of distribution.

One Type TA regulator will regulate any number of generators providing they are operating in parallel, with exciters also operating in parallel. The generators regulated may be either alternating or direct current.

Figs. 3, 4 and 5 show speed, ampere and voltage curves of a 75 Kw. generator operated without regulator. Figs. 6, 7 and 8 show speed, ampere and voltage curves with voltage regulator. These curves were all taken with the same recording instruments and from the same generator; the generator was driven by a shunt motor, no attempt being made to regulate the speed, but at times the speed was varied to quite an extent, purposely to show the effect of speed changes on the voltage regulators. No attempt was made to regulate the voltage of the generator after it was once set at 115 volts. The exciter was mounted on the shaft of the generator, and thus subject to the same speed variations.

#### Feeder Regulators

The voltage regulators referred to above are designed to control the voltage of the generators. This type of regulator may control the voltage of the generator so as to deliver the proper voltage at some one center of distribution, but as the distributing system fed by a central station usually includes several centers supplied by different feeders, it is necessary to have means of independently adjusting the voltage of each feeder.

For this purpose, the General Electric Company has for several years supplied hand or motor control Type CR, MR, or SR regulators, which need no description here.

The engineers of the Company are working on devices for automatically regulating feeder circuits. It is hoped that definite information regarding these devices may be supplied at an early date.

## RAILWAY APPARATUS

#### COLUMBUS, BUCKEYE LAKE AND NEWARK TRACTION CO., COLUMBUS, OHIO

This company has ordered a 1500 Kw., three-phase, revolving field, engine-driven generator to supplement the two 850 Kw. generators that we have already installed in the Hebron station. The original station was intended to supply power for the road running between Columbus and Newark, but a line 27 miles long has since been built between Newark and Zanesville, and two additional sub-stations have been located at Newark and Pleasant Valley for the operation of this road. These sub-stations will be operated from the Hebron power house, and the same class of high speed interurban service will be given on this line as is now maintained between Columbus and Newark.

The Hebron station as now operated is one of the most economical in Ohio.

#### THE MANHATTAN RAILWAY COMPANY

When the management of this railway company decided to replace their steam apparatus with electrical apparatus the work was necessarily very slow, as each steam train was retained in service until the electric train was ready to take its place. The last steam engine was taken out of passenger service on June 25th, and from now on, it is the intention of the management to run the service electrically. There are 840 motors in operation. The success met with at this installation was discussed in the previous issue of the REVIEW and is a great victory for the electrical apparatus and the General Electric Company.

## LIGHTNING ARRESTERS

#### MULTIPLEX LIGHTNING ARRESTERS

Within the last month or two attention has been called repeatedly to a new method of installing alternating current lightning arresters whereby they would not only act as a protection against lightning but equally as well act as safety valves to discharge any abnormal voltage strains which might exist either

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between line and ground or line and line. Such an arrangement possesses considerable merit, as demonstrated by repeated tests, and should be more universally used. This arrester will be known as the "Multiplex Arrester" because of its multi-functions in preventing excessive voltages from any cause, such as resonance or capacity effects, sudden opening or closing of switches, lightning, static effects, etc.

## LIGHTING

### IMPROVEMENTS IN SERIES ALTERNATING STREET LIGHTING SYSTEM

All representatives of the General Electric Company will be glad to know of improvements which have been made in connection with our series alternating system. From time to time, slight changes have been made which the engineers have felt would make the system even more durable and satisfactory in operation. The improvements referred to below, however, are of an important character, and offer evidence that the General Electric Company not only keeps abreast of the times, but still remains the leader in connection with arc lighting engineering.

#### Improvements in Constant Current Transformers

There is an increasing demand for constant current transformers that can be operated at a high power factor when partially loaded.

In laying out a distribution system for arc lighting, it frequently becomes necessary to make provision for growth; i. e., additional lamp installations on the circuits. As an illustration, an engineer may desire to install forty-lamp circuits with provision for a future operation of fifty lamps, as the demand increases. In other instances, it frequently happens that during the summer months there is a demand for lamps at resorts, etc., which are not required during the winter. It, therefore, is necessary in either case to install transformers capable of meeting the maximum requirements of the circuits, but which will operate at high efficiency and power factor at partial loads.

The General Electric Company has produced a design of transformer which meets the above conditions admirably. By a combination of taps on the primary and secondary coils, practically full load efficiency and power factor can be obtained at 60, 70, 80, 90 or 100% load.

Ample regulation can be obtained on any tap; for instance, a 100 light transformer will regulate to at least 33 lamps on the 60, 70, 80, 90 or 100 lamp taps with the falling current adjustment necessary to obtain a constant arc wattage. With a constant current adjustment the transformers will regulate somewhat lower.

In appearance, the transformers are very similar to the standard air-cooled designs, with the exception that additional leads are brought out of the cases for partial load operation. It should be noticed that no sacrifice of desirable characteristics has been made to obtain these additional features. The coils are vacuum dried, compound filled, and possess all the fine qualities of insulation, regulation, and mechanical construction found in the previous standard air-cooled designs.

#### Improvements in Series Alternating Lamps

For some time we have been furnishing 12″ upper carbon closed base enclosing globe type of series alternating lamps. This lamp when operating at 6.6 amperes, will give a carbon life of 100 to 120 hours. This long carbon life, together with the feature of trimming through the bottom of the stationary outer globe has made the lamp very popular.

The 12″ upper carbon trim has now been adopted as standard for the open base enclosing globe type of series alternating lamp. The general construction of the lamp has not been changed. The lower frames have been lengthened the required amount to allow for the longer lower carbon and the dimensions of the enclosing and outer globes proportionately changed. The estimated carbon life of

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this lamp at 6.6 amperes is 110 to 130 hours, this offering a considerable advantage in reduced maintenance expense as follows.

**Decrease in Enclosing Globe Breakage**

It is a well-known fact that a great portion of enclosing globe breakage is due to the abnormal condition of the arc at first trimming with new and full length carbons. Also, a large percentage of breakage is due to the handling of the globe in cleaning and retrimming. It is very evident that a decrease in the number of trimmings per year has a direct bearing upon the amount of inner globe breakage.

**Decrease in Trimming Expense**

With an increase in life of approximately 30 hours, less frequent visits of the trimmer are necessary; and less labor is required in the cleaning and transportation of the inner globes, thus reducing one of the largest expenses of series lamp maintenance.

**Enclosing Globe Cap**

We have found from experience that our series lamps are oftentimes required to operate in such an atmosphere as is destructive to the iron enclosing globe cap. In order to avoid any such occurrence, all series lamps are now furnished with a cap composed of a strictly non-corrosive aluminum alloy metal, thus ensuring a permanent surface for the best possible contact with the enclosing globe surface.

## MUNICIPAL LIGHTING

**Troy, Ala.**

When the city of Troy, Ala., was considering the subject of arc lighting, the following letters were among those received by the Mayor. These letters speak for themselves:

MONTGOMERY, ALA., June 17, 1903.

HON. CHAS. HENDERSON, MAYOR,
TROY, ALA.

DEAR SIR:

I have a written request to-day from the General Electric Company, asking that I give you our experience with their series alternating arc lighting system, and it is with pleasure that I do so. About two years ago we installed this system, about 300 lamps, and have met with first-class success. The light is good and reliable, and the lamps are easily maintained, and our opinion is that it is the best system of street lights you could adopt.

Yours very truly,
(Signed) R. J. CHAMBERS,
Superintendent,
Montgomery Lt. & Water Pr. Co.

---

June 17th, 1903.

HON. CHAS. HENDERSON, MAYOR,
TROY, ALA.

DEAR SIR:

At the request of the General Electric Company, I give you our experience with the series alternating arc light system.

In January, 1901, we made the change from the direct current open arc system and are altogether pleased with the change.

There are several points to be considered:

1st. You only have one engine and one dynamo to look after and keep up.

2nd. The lamps require trimming (on a moonlight light schedule) about once in two weeks. A saving in carbons and cost of trimming.

3rd. The service is more satisfactory because the lamps seldom get out of order and rarely have one out. The distribution is better than the open arc, being equal in all directions. There is no flickering.

The lamp burns steadily, very much as the incandescent lamp does.

If you should make the change, you will not make a mistake and will be pleased with the results.

Yours truly,
(Signed) JAMES M. McLARNON,
City Treasurer,
Chester, S. C.

---

BIRMINGHAM, ALA., June 18, 1903.

HON. CHAS. HENDERSON, MAYOR,
TROY, ALA.

DEAR SIR:

We have a letter from Mr. F. M. Laxton, of the General Electric Company, Atlanta, requesting us to give you our experience with their series alternating arc lamps.

We have had in operation for about four months about 400 of these lamps in Birmingham and 100 in Bessemer. The results we have ob-

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tained from them have been excellent, practically no trouble whatever having arisen since their installation. The cost of operation and maintenance is greatly reduced as compared with the old style open arcs.

If you are contemplating the installation of an arc lighting system, we heartily recommend to you the General Electric Company's series alternating system. We will be glad to furnish you with any further information you may desire regarding them.

Very truly yours,

(Signed) J. M. BRADLEY,
Supt. Elec. Dept.
Birmingham Ry., Lt. & Pr. Co.

---

June 20, 1903.

HON. CHAS. HENDERSON, MAYOR,
TROY, ALA.

DEAR SIR:

I am in receipt of a letter from Mr. F. M. Laxton, of the General Electric Company, requesting me to write you in regard to the series alternating arc lighting system, manufactured by the General Electric Company. In this connection, I take great pleasure in stating that my Company is using this system very extensively, having in operation some six hundred lights. We have found the system highly satisfactory, and have adopted it after trying several others. If in any way I can serve you, kindly command me.

Very truly,

(Signed) H. T. BROWN,
Engineer,
Railways & Ltg. Co. of America.

### ROTARY CONVERTERS FOR DIRECT CURRENT LIGHTING

We have closed contract for supplying apparatus for a plant to be used for lighting Governors Island.

The current is supplied from the circuits of the Edison Electric Illuminating Company of Brooklyn at 6600 volts, 3-phase, 25 cycles. The current will be conveyed under the Buttermilk Channel by triple conductor armored cable and transformed at the sub-station on the Island to 250 volts direct current, three-wire system.

The sub-station apparatus will consist of one TC 4-150 Kw., 750 R.P.M., 250 volts rotary; two 87½ Kw., "T" connected step-down transformers, with neutral tap for three-wire system; one 15 Kw., motor operated, induction potential regulator; and one special switchboard for the control of rotary, transformers and the circuits.

A special tap is provided on the step-down transformers, and the switchboard is arranged so that in the event of the shutting down of the rotary for any reason the three-wire system can be supplied direct from the two transformers at 25 cycles.

### MANCHESTER, N. H., STREET LIGHTING CONTRACT

The Manchester Traction, Light & Power Company has just closed a new contract with the city of Manchester, N. H., for about 600 arc lamps of the enclosed series alternating type. The contract calls for the lights to be furnished all night, every night, and that the wattage of each lamp shall be at least equal to that used with the old system. The old system was the open T.-H. arc lamp, operated from a 125 light Brush arc machine at 9.6 amperes.

We have been awarded the contract for the apparatus which will be installed about the 1st of September. The contract covers the following material:

Seven 100 light constant current transformers with switchboards.

600 arc lamps, complete with reflectors, cut-out boxes and other necessary appliances.

Two other manufacturers offered their systems in competition with ours, but were practically not considered, as the purchaser felt that the G. E. was the only system on the market worthy of consideration.

### CONSTANT CURRENT TRANSFORMERS
**Bangor, Me.**

We have just been awarded a contract for an additional 100 light air-cooled constant current transformer by the City of Bangor Municipal Plant, Bangor, Me.

### MARINE GENERATING SETS
**Erie Railroad**

The above company is building three new ferryboats for their New York and Jersey

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City service, and have contracted with us for an equipment for each boat consisting of two marine generating sets, MP 6-15-400, the sets to be equipped with tandem compound engines.

**CARTERET ELECTRIC LIGHT & POWER COMPANY,**

**Carteret, N. J.**

The above company is increasing its three-phase equipment by the addition of ATB 32-150Kw-225 engine-driven generator, with belted exciter, marble switchboard panel and one constant current 8.8 Kw. air cooled transformer for supplying circuit of 240 25 C.P. street lamps.

Separate circuits are employed for lighting and power, the lighting circuits being single-phase, and no difficulty has been found in balancing the circuits close enough to insure the same potential in the three legs.

The air cooled transformer supplies a circuit of lights located in a town three miles from the plant, for which reason it was found expedient to employ a 5½ ampere current in order to get all the lamps on one circuit.

As only 170 lamps will be operated for the present, the transformer will be provided with partial voltage taps so that it may operate at maximum power factor with the partial load.

**DANBURY GAS & ELECTRIC COMPANY,**

**Danbury, Conn.**

The above company is increasing its station equipment by the addition of one ATB 32-150Kw.-225 engine-driven generator with belted exciter, marble switchboard, for incandescent and arc lighting, and three 50 light constant current transformers to operate one hundred and thirty 6.6 amp. arc lamps.

**NASSAU LIGHT & POWER COMPANY,**

**Roslyn, N. Y.**

A contract has been placed with us for two AQB 8-1500-900, 2300 volt Curtis turbine sets for installation in the spring of 1904; the order also covers a complete outfit of switchboards for the station.

**DOUBLE CURRENT GENERATOR**

**G. H. Robinson, Northport, N. Y.**

We have installed for the above a plant which is novel in some respects.

The generating plant consists of Walrath gas engine, belted to one ACT 4-20Kw.-1800, double current generator, delivering 110 volt, 3-phase alternating current and 160 volt direct current.

The direct current end is used for charging storage batteries and for supplying lights in the neighborhood of the plant, and in one adjacent house; the storage battery being made use of to reduce the voltage to that required by the lamps.

The alternating current end of the generator supplies three step-up transformers raising the voltage from 110 to 2200 volts, which supplies two other houses, one located one mile and the other two miles from the generating plant. At these houses the current is stepped down to 110 volts for the lighting circuits.

**DIRECT CONNECTED GENERATOR**

**Insane Hospitals**

A contract has been closed with French & Hubbard, Engineers, for six 50 Kw. 125 volt direct connected lighting generators for the Worcester Insane Hospital, Worcester, Mass. This order was given to us in competition with six other manufacturers, all of whom quoted prices lower than the General Electric Co., thus showing the confidence which their engineers have in G. E. apparatus.

Another contract has been closed through the same engineers with the "State Colony for the Insane," Gardner, Mass., for an ATB 26-66-276-2300 volt, direct connected generator, this being the first of a new line of small direct connected alternators sold by the Boston Office. We are told by the Consulting Engineers that this size of machine fills a long-felt want for a small direct connected alternating generator and that many sales may be looked for along this line.

**SERIES ALTERNATING SYSTEM IN OAKLAND, CAL.**

The first order for Series Alternating

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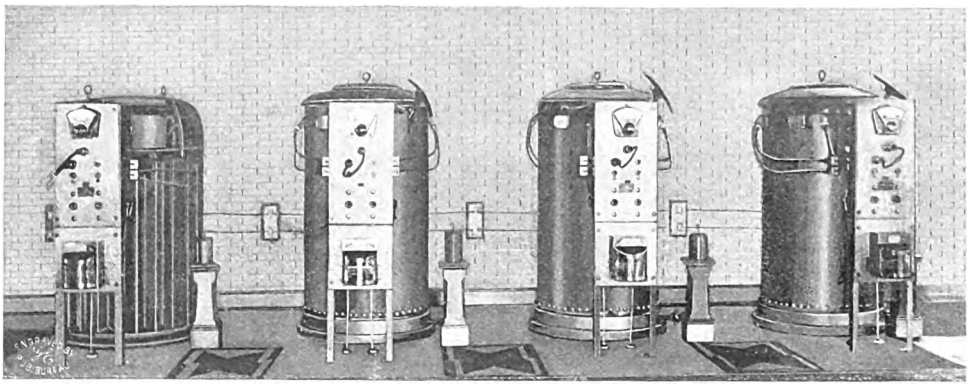
Lamps received from the Oakland Gas Light and Heat Company was in 1901. This original order was for one 50 light constant current transformer, with panel, but without sub-base and wattmeter.

The transformer supplied on this order was of the old cast-iron type. After this order was placed and before the apparatus was shipped, the Oakland Company, realizing the great advantages to be obtained from metering the current supplied to the various street light circuits and comparing this to the lamp hours burned and also to the amount of money received for this service, placed an order for a sub-base and wattmeter to match the panel, and have since so equipped all transformer panels purchased.

the top of the cut-outs and the Oakland Company purchased insulator type cut-outs of various manufacture, finally adopting for its early lamps an insulator hanger consisting essentially of an ordinary triple petticoat glass insulator with suitable hook attached thereto.

The General Electric Company has since brought out the absolute cut-out and hanger, known as Form 3, which combines this insulator with the absolute cut-out, and the Oakland Company has now adopted this as its standard practice.

To return to this original sale: When this transformer arrived, it was set up in a temporary position at the works and the lamps were purposely installed about 25 to



**Constant Current Transformers Installed at Oakland, Cal.**

The panels supplied with this first transformer and with the next five ordered by this company were of the early type, with the circuit current passing through the ammeter. The Oakland Company has since adopted the 20″ panel as the standard for all transformers installed in Oakland and other places under its control and has also accepted the current transformer for use with the ammeter as being the only safe practice.

The first equipment of lamps was sold without the absolute cut-out and hanger but experience soon demonstrated that it was advisable to so equip these lamps. When these lamps were installed it was found that the hangers had a tendency to "ground" in

30 feet from the ground in a district where there were a great many trees, as much had been said regarding the great diffusing character of the light from these lamps.

When the lights had been burning a few nights, the City Electrician, at the invitation of the Oakland Company, visited this district and, with the Company's Superintendent, made a careful inspection of the lamps. He expressed himself as being very well pleased with their operation, particularly with their steadiness and freedom from shadow beneath the lamp. It was also found to be a fact that the shadows from this lamp were less marked than with the old open arc lamp.

There were undoubtedly certain points

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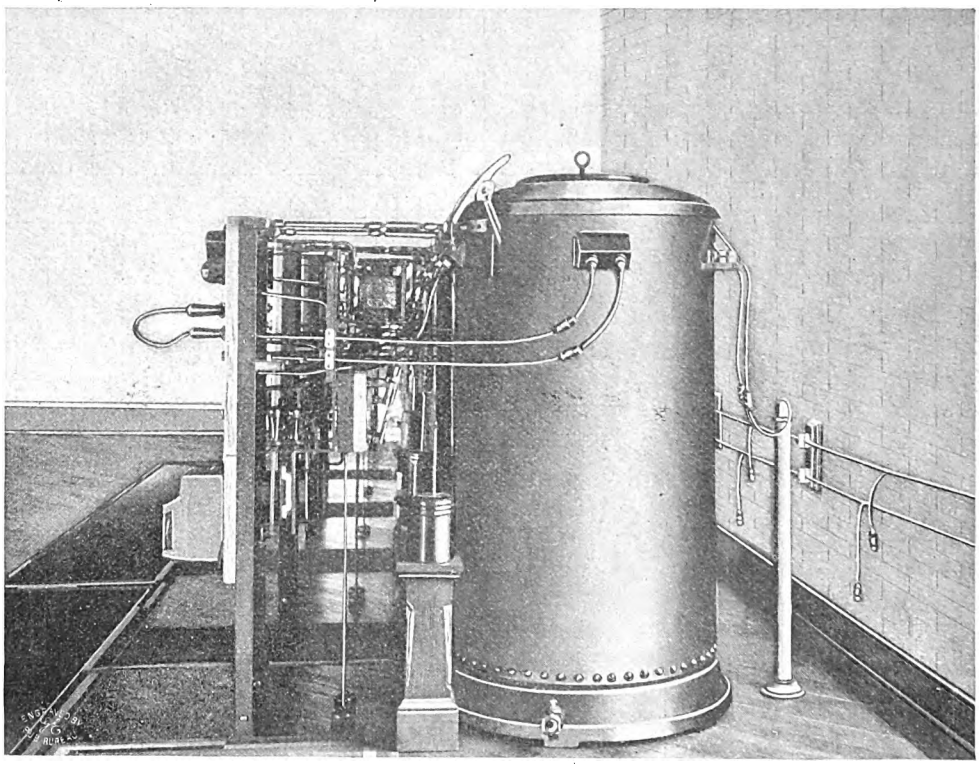
that received a more intense light from the open arc lamp than from the enclosed lamp, but these points were confined to a very small zone a few feet beyond the shadow underneath the old lamp and the general illumination of the new enclosed lamp was much better than the old open arc lamp. The open arc lamps in this case were 9.6 amperes and new enclosed lamps 7.5 amperes of the old Form 1 type.

done as it was found that the saving in copper and transformer cost was not sufficient to offset the additional trouble experienced in operating the system at the high voltage obtained when using the one hundred-light transformers. With this order was also placed an order for a spare panel. It now became necessary to install these transformers in a permanent place and the Oakland Company selected one side of its dynamo floor for this purpose.



**Constant Current Transformers at Oakland, Cal. (Side View)**

As these first lamps proved so satisfactory, the Oakland Company placed a second order with our Company for 50 additional lamps. These lamps were of the Form 2 type and the Oakland Company states that their operation showed a marked improvement over the earlier type of lamp.

The third order followed and was for 100 lamps with two fifty-light transformers, the Oakland Company having adopted the fifty-light transformer as a standard. This was

This was an old wooden floor and was first covered with a fireproof covering and then laid out in panels, four transformers to each panel. The panel borders and wainscoting were of black walnut and the body of polished Oregon pine laid diagonally. A long rubber mat was placed in front of the installation and small mats between the transformers for the operator to walk on (as shown in the accompanying illustrations). These cuts also show several novel features which were suggested

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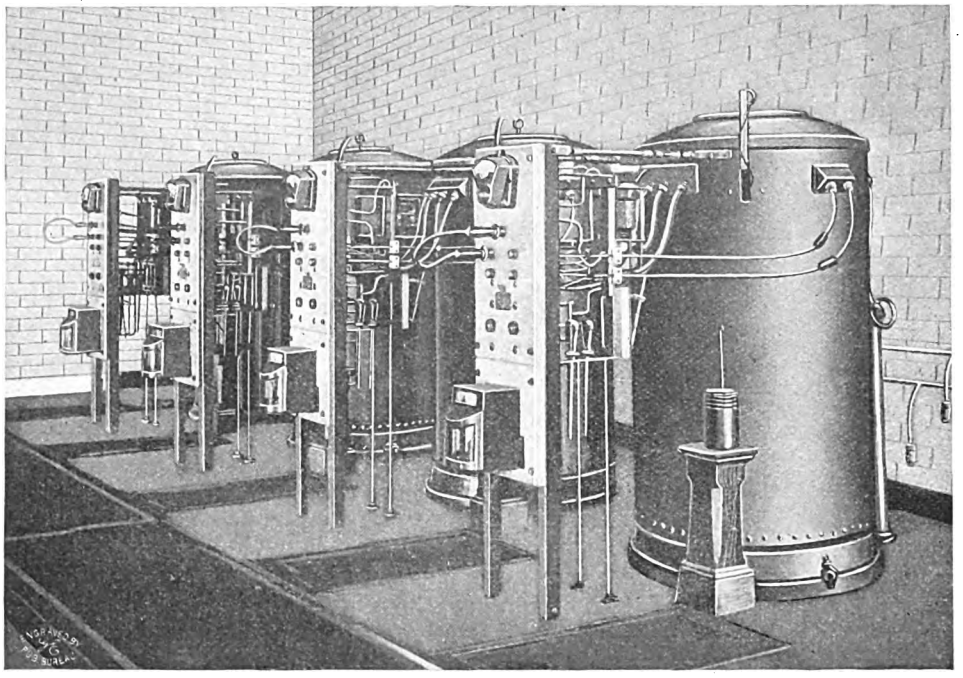
by Mr. W. C. Hughes, who has charge of all matters pertaining to the company's dynamo rooms.

Glancing at these illustrations, it will be noted that they are entirely free from overhead wires. Underneath these transformers is run a three-phase 2300 volt, three-wire lead, to which the panels are connected by the two wires coming up through the floor just behind the panels. The transformers are connected alternately to each of the three phases, thus keeping the circuit balanced into one switchboard. This enables the attendant to pass entirely around the transformers and leaves an absolutely unobstructed head room which facilitates the removal of the internal mechanism of the transformer. As a matter of fact, they have never had occasion to do this except in one case and that was in the case of the first transformer, which developed a ground due to a slight abrasion of the insulation of the movable coil. This, the Superintendent informs us, was probably due to the number of times which this transformer



**Constant Current Transformers at Oakland, Cal. (Side View)**

This three-phase lead is connected to an automatic triple-pole oil break switch on the main switchboard so that the whole installation can be cut off at once in case of serious trouble.

The arc circuit, itself, in place of leaving the panel at the top and passing overhead, is carried back into the transformer and out again at the back, being lead away down the pipe shown in the illustration.

It is also noticed that each transformer, panel and circuit is regarded as a unit in itself, no attempt being made to combine the panels was moved about to various temporary locations before being permanently installed, as just described.

The arrangement for carrying the circuit around the inside of the transformer was very simple. Small stirrups carrying a "Duggan" cleat were hooked over the edge of the case and the wire run in these cleats to the back where two holes were drilled and bushings placed. The cover was then put back, the weight of the cover serving to keep the stirrups in place.

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As the size of the installation increased, the question then came up as to how to install a spare transformer so that it would be readily available to take the place of any other transformer, which, through any cause, might become inoperative. Several methods were suggested, one that all circuits be brought to a common marble transfer board, to which board were also to be brought the transformer terminals, then any circuit could be plugged to any transformer, including the spare transformer.

This arrangement was costly and also rendered the wiring extremely complicated, so was abandoned. The next suggestion was to have a long cable connected to the spare transformer, which cable would reach to any other transformer. This necessitated putting the spare transformer in the center of the installation in order to shorten the length of the cable. This was objectionable as they were not ready to install the spare transformer and also when the installation was complete the long cable would be objectionable, both from its appearance and the objectionable feature of having a cable lying on the floor where it might be damaged.

A study of the illustrations will show the means adopted. Looking at the front view of the transformers a pair of wires will be noted running behind all the transformers. This lead corresponds to the street circuit from the spare transformer. Looking at the side view, the details of this connection can be seen. It will be noted that opposite the back of each transformer is a pair of hard rubber couplings which corresponds to the hard rubber couplings furnished with the tranformers. In case of an accident to either transformer or panel it is only necessary to undo this hard rubber coupling and couple the circuit on the spare transformer lead. This makes a very simple and inexpensive arrangement, and enables the spare transformer to be connected in any position in the bank, or to be used as an active transformer in case of a new circuit being added before another transformer could be purchased.

Another very handy feature is the small stand shown at the right of each panel. The directions for operating these transformers say, "move the secondary (movable) coils as far as possible from the primary (stationary) coils by raising the projecting arm." This the Oakland Company does by removing the weights when the circuit is shut down and placing them on these small stands, as shown in the illustrations. In starting, the operator first closes the primary switch and immediately hangs the weights in place.

Another benefit of this system of arc lighting, of which the Oakland Company has taken advantage in its fourth order is the ability to locate the transformers in a position near the lamps they are to supply. The Oakland Company has a sub-station in its annexed district fed by a heavy three-phase lead. In place of putting its fourth order for transformers in its main station and conveying its arc circuits about four miles to this district, the two transformers on its fourth order were placed in this sub-station thus saving sixteen miles of wire and insulation, to say nothing of the benefits from shortening up the circuits.

After the experiences above referred to, the Oakland Company has just placed an order with us for thirteen fifty-light transformers and six hundred arc lamps, which will be sufficient to complete the change to series alternating lamps on its entire system of nine hundred lamps.

Realizing the disadvantage of having such a quantity of oil in the station, the Oakland Company has (after a visit of the General Superintendent of its Electric Department to our factory who throughly investigated these matters) specified air cooled transformers in this last order.

It has also specified for these lamps the ornamental type, using a 12-inch carbon in place of the 9½-inch carbon used heretofore. And has placed an order for the necessary parts to change the 300 lamps it now operates, to burn the 12-inch carbon.

### MULTIPLE ENCLOSED ARC LAMPS IN THE CITY OF SAN FRANCISCO

The popularity of the Form 3 multiple

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lamps in the city of San Francisco is quite noticeable. On all sides the enclosed arc lamp of General Electric manufacture can be seen, while the absence of lamps of other manufacture is easily noticed.

The San Francisco Gas & Electric Company has used the G. E. enclosed arc lamp exclusively since their first introduction, and on its A. C. and D. C. systems 2000 enclosed lamps are in operation.

The Independent Electric Light & Power Company, also in the city of San Francisco, has purchased about 3500 of the Form 3 A. C. ornamental type of lamps for use on its system. It has approximately 3000 lamps in actual operation, and the small amount of trouble met with in their operation is greatly to the credit of the Form 3 lamps.

## POWER APPLICATIONS

### ELECTRICITY EMPLOYED IN HANDLING ORES IN LARGE SMELTERS

The employment of electrical apparatus in the handling of ores and smelted products in smelters is a comparatively new feature.

The American Smelting & Refining Co.'s Globe Plant has a very complete electrical equipment. Its generating plant consists of two 150 Kw., 575 volt generators belted to Corliss engines, with General Electric latest type railway generator and feeder panels.

The ores treated at this plant are received in box cars which are switched to a long series of bins through which runs an endless bucket conveyor 300 feet in length; the power supply being a 25 H.P. motor, which conveys this ore into chutes and enables one of our LS-203 locomotives, fitted with a body for holding this ore, to receive its load and distribute it anywhere throughout the entire length of the building. This work was formerly accomplished by about 80 men with wheelbarrows, consisting of day and night shifts.

The roasting rooms contain some 24 large drum automatic roasters, all operated by a 75 H.P. motor. This work ordinarily would require 30 or 40 men.

The ore crushers and rollers are all operated by appropriate motors.

The furnaces or cupolas are arranged in a long row with a track leading to each. This enables a slag pot, to be run down to receive the smelted metal drawn from the furnaces. This work is all handled by four of our LM-101-B-2, 500 volt locomotives, one being required to haul three slag pots. These slag pots when fully loaded weigh 13,000 pounds, making a total load of 39,000 pounds per locomotive. The grade from the mouth of the furnaces is 3½%, and continues at a somewhat less grade to a "Y" switch from which the slag pots are hauled up an incline of 5% to the slagging furnaces into which the contents of the pots are poured. The entire handling of the contents of these slag pots is done by the locomotives, and it may be added in passing that it formerly required the labor of 24 men and 24 mules to accomplish the same work at a necessarily increased length of time.

This plant is one of many operated by the American Smelting & Refining Co. where new methods of treating ores have accompanied new methods in handling. They have found that this method of handling not only increases their output, but effects a great saving in operating expenses.

### ELECTRICAL DEVELOPMENTS IN SOUTHERN CALIFORNIA

Southern California stands pre-eminent among productive sections of the United States as a district where great attainments have been reached through the use of irrigation. The lines of the Edison Electric Company of Los Angeles extend over many miles of country which was originally unproductive, but which has been rendered by the use of pumping plants one of the greatest orange raising districts of the world. This system of generating and distribution of power has been described completely in a previous issue of the REVIEW, but it may be of interest to note

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the large number of pumping plants which are now in operation using current from the high tension transmission lines. In the vicinity of Redlands there are about thirty-six pumping plants ranging in capacity from 5 to 75 H.P.; in and about Pasadena there are about twenty-five such plants; in and about Pomona fifteen, and in the Santa Ana region five.

In numerous places centrifugal pumps are used, the heads being in some instances as high as 140 feet. In one instance water is pumped in four different stages, the pipe line of one stage being about seven miles in length.

Another application of induction motors is that of driving the various machines used in the production of cement near the town of Colton. Motors from five to seventy-five H.P. are used, aggregating about 400 H.P.

At Redlands an elevator is operated by a General Electric Form "K" Induction Motor of 30 H.P. capacity, with excellent results. At another point a motor-generator set is used for charging the batteries of electric automobiles for public service; various small sets for private use are operated at different points on the system.

To the above mentioned industries using alternating current, may be added brick yards, saw mills, packing houses, etc. School buildings, restaurants and other buildings, use small induction motors for ventilation.

The Edison Electric Company, in carrying on construction work at its new plants, has operated extensively the General Electric Form "M" induction motor for driving hoists, and has also installed motor-driven air compressors for operating drills.

### PIEL BROS. STARCH COMPANY, Indianapolis, Ind.

The above company is just completing a new starch factory at Indianapolis, which it expects to put in operation about August 1st, 1903. Mr. W. F. Piel, Jr., the president of this company, was connected some years ago with the W. F. Piel Starch Co.—a business founded by his father—and when that concern was absorbed by the National Starch Co., he was elected president of the new company. He held this position until quite recently, when he resigned and organized with his brother the "Piel Bros. Starch Co."

In building the new factory Mr. Piel has endeavored to make it a model plant in every respect, and has equipped it with all modern improvements.

The factory will be motor driven throughout and should be of special interest to the General Electric Co. from the fact that all electrical apparatus used will be furnished by us, including generators, switchboard, motors, wire and supplies.

The electrical equipment consists of two 200 Kw., belted, 60 cycle, 240 volt alternators with compensating exciters, each driven by an Allis-Corliss engine; blue Vermont marble switchboard with two generator and one feeder panels; and standard induction motors, varying in size from 10 to 100 H.P.

The motors are all belted either to a short section of line shaft or in some cases direct to the machines. Part are mounted on the floor and part suspended from the ceiling.

A separate set of feeders is run from the switchboard for light and power, in order that the light circuits may be controlled from the engine room.

### LARGE INDUCTION MOTORS IN MINING OPERATIONS AT BUTTE, MONTANA

For over twenty years copper has been mined extensively at Butte and very large steam machinery has been installed. Only within the last two years has electricity been applied to any considerable extent. About two years ago three transmission plants were completed, delivering into Butte about 10,000 H.P. This power has been sold to the large mining companies at from $54.00 to $60.00 per H.P., while steam power has cost them from $75.00 to over $100.00 per H.P.

Two years ago the Colorado smelter installed three 300 H.P., 2080 volt, Form "K," induction motors, belted to their line shafting, and by these motors operate practically their entire works.

At the Never Sweat compressor plant of the Anaconda Copper Company they had

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four large steam air compressors. Two years ago they purchased an 800 H.P., 2080 volt, Form "K," four-bearing motor, with friction clutch and grooved pulley, to drive the largest compressor. To apply this power, they disconnected the steam end of the compressor, removed the rim of the fly-wheel and substituted a grooved rim for rope drive, using the fly-wheel as a driving pulley. This unit has been in operation for about a year and has recently been operated continuously without a shut-down for seventy days. In addition to the above, they operate a number of small motors, about 50 H.P. each, for various work above ground, a 50 H.P. motor-generator set furnishing power for two or three small locomotives, and are just installing a 100 H.P. hoist in a mine operated by a Type "M" induction motor.

About nine months ago the Montana Ore Purchasing Company installed a 600 H.P., 2080 volt, four-bearing motor with friction clutch, to drive an air compressor at the Rarus Mine, and arranged it similiarly to the one at the Anaconda property, and now they have an order in for a duplicate unit. This company also has a 500 H.P. motor installed at its Cora Mine and uses electric power extensively in its smelter, operating cranes, etc.

The Butte Reduction Works are operated entirely by electric motors. They have a 600 H.P., 2080 volt, four-bearing motor with friction clutch and grooved pulley, installed in their former engine room, and a portion of the drive ropes run to the main shaft of the concentrator and the balance to the main shaft of the smelter. In addition to this, they operate a number of motors of from 30 to 150 H.P. amounting in all to about 2700 H.P.

An order has just been placed with the General Electric Company for two 525 H.P., 2080 volt, Form "LM," belted motors to operate compressors for the Colusa Mining and Smelting Company at Butte, Montana.

**AYER & LORD TIE PRESERVING COMPANY, Carbondale, Ill.**

The above property situated in the southern part of Illinois, covers approximately 300 acres, 150 of which is in commission at present and is used for chemical treatment of railway ties.

This is the first plant of its description to adopt electrical apparatus for operating, and the main feature is rope haulage for manipulating the trucks loaded with ties to be treated.

The apparatus installed consists of two 75 Kw., 500 volt, belt-driven generators, complete with generator and power panels, and is used for the purpose of operating, in addition to hoists for rope haulage, motors in machine and repair shops, also pump located some distance from the plant, and for lighting of buildings and grounds, the first by incandescent and the latter by arcs.

The original contract called for eight double friction drum hoists, each having a capacity of 5000 lbs. haul with a rope speed of 200 feet per minute. These hoists of Lidgerwood make are equipped with G. E. controllers and are operated by GE-58 motors.

At the present time there are four hoist outfits installed, two located 1000 feet north of the treating plant, and an equal distance from the north end of the storage yard, the other two 1000 feet south of the treating plant and the same distance from south end of the yard.

The method of handling is to operate each drum independently, one drum handling a load of cars 1000 feet, when the second rope is engaged and completes the haul of 2000 feet, which carries the cars into the treating tanks or to the shipping point, as the direction of haul may determine.

The previous custom has been to use steam for this class of work, which necessitates long steam leads, with very poor economy. We are informed that 68,000 ties are turned out at the Carbondale plant in two weeks.

This enormous output is credited by the purchaser to the facility for handling cars by means of electric rope haulage. The economy of operation far exceeds the expectation of the Ayer & Lord Company. The same

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method of operation has been adopted by the Mexican Central Railway in Mexico.

The hoists were conservatively designed and information has just come to hand that the work performed by one hoist was to move 18 loaded tram cars, each weighing 8000 lbs., up a 6⅔ per cent. grade, which is extremely satisfactory as the hoist is only designed for 5000 lbs. rope or draw-bar pull.

The additional four hoists will be installed as the land is prepared to take care of the track facilities.

While this class of haulage is not new, still it opens up a new field for electricity as a distributor of cars in works of this and other descriptions, and reflects great credit on Mr. W. W. Curtis, the Consulting Engineer.

### PAPER BAG COMPANY

The Continental Paper Bag Company of New York, has closed a contract with the General Electric Company to supply its mill at Rumford Falls, Maine, with twenty 550 volt, Form L, 40 cycle induction motors aggregating 340 H.P. The contract also includes the necessary transformers and controlling panels.

This is another instance of the confidence shown by the paper trade of New England in apparatus of General Electric Company manufacture.

### COTTON MILL PLANTS IN THE SOUTH

We have recently secured contract with the Union Manufacturing & Power Co., Union, S. C., for four 1300 Kw., 13,200 volt generators. These machines will be used, in part, for driving their own mill for which they have ordered from the General Electric Co. five 200 H.P. and one 150 H.P. induction motors. A large portion of the current generated will be transmitted a distance of about ten miles and furnished to two outside cotton mills who will purchase their power of the Union company.

### SUGAR HOUSES

During the past month we received an order from the Kilby Mfg. Co., of Cleveland, O., to supply switchboard equipment for six sugar houses located at Menominee, Mich.; Windsor, Colo.; East Tawas, Mich.; Owosso, Mich.; Fort Collins, Colo.; and Longmont, Colo.

This order is particularly gratifying for the reason that it is largely made up of standard panels, a total of 32 panels being ordered of which 26 are standard.

We secured this order in the face of severe competition, because of our ability to make prompt shipment.

The following classes of panels are included: 14 generator panels, for use on three-wire system with balancer set. Total kilowatt capacity 1140. 12 two-wire feeder panels, standard, each containing from two to eight circuits. Total kilowatt capacity 1815. 2 170 Kw. balancer panels, semi-standard. 4 three-wire feeder panels, semi-standard, 200 Kw. capacity each.

Besides the panels we are to furnish 665 constant potential lamps and 60 standard cabinet panels, complete with cut-outs, lightning arresters, voltmeters, fuses, etc, etc.

### SMALL MOTORS

The Albany Electric Illuminating Company have recently placed an order with the General Electric Company for 53 CA and CE 500 volt motors of various capacities, to replace an equal number of 110 and 220 volt direct current motors of *various makes* at present in use on their lines.

### ENCLOSED TYPE MOTORS

#### John A. Mead Manufacturing Company

The specifications issued by the above parties covering motors for their coal handling apparatus call for apparatus to be entirely enclosed when running continuously at a moderate temperature, this type of motor being desired on account of the dusty location in which the motors have to be placed.

We have therefore developed for this use a number of sizes of CL and CE motors, furnished with enclosing covers, and provided either with blowers mounted on a casting attached to the foot of the motor and belted to the motor shaft by a round belt or provided with a fan mounted on the armature shaft between the commutator and the outboard bearing.

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These motors have proved very satisfactory in operation as they are practically dust-proof, and operate at a temperature only slightly in excess of the open type motors.

### 60 CYCLE ROTARY CONVERTERS

The Syracuse Lighting Co. is equipped with General Electric 60 cycle, 2300 volts, 3-phase alternators for supplying general lighting and power.

On account of the large direct current motor load in use at the time the polyphase apparatus was installed, it was deemed inexpedient to change to an alternating system for operating the motor, and therefore the power for the motor load is supplied through 60 cycle, 600 volt rotary converters.

The following letter is of interest:

SYRACUSE, N. Y., June 29, 1903.

H. H. CROWELL, MANAGER,
SYRACUSE, N. Y.

DEAR SIR:

In reply to your letter of the 26th, we have in use now two 300 Kw. rotary converters. One has been in service constantly since October, 1900, and the other since November, 1902, both machines running on an average 14 hours daily. We are using both machines to furnish 500 volt direct current for stationary motors, the average load being about 500 amperes, the peak being not over 700 amperes. Current is furnished both rotaries from 600 Kw., 2300 volt, 3-phase direct connected generators.

During last winter, when our A. C. load was very heavy, we used the rotaries to help out, giving them power from an 850 Kw. 500 volt direct connected unit. Under all conditions both rotaries have given perfect satisfaction and up to the present writing have not cost anything for repairs.

Yours truly,

(Signed) E. B. DOEN,
Supt.

It will be noted that these rotaries have been taking current from the direct current 500 volt machines and run in multiple on the A. C. side with the 600 Kw. generator in order to help out the alternating generators at heavy load.

### ELECTRICALLY OPERATED CAR SHOPS

The new shops of the C., R. I. & P. Ry., at East Moline, Illinois, will be equipped electrically throughout. Direct current was selected by the engineers of the road as best adapted for the work, on account of the large number of variable speed motors required for gearing to machine tools.

The multiple voltage system was given careful consideration, but the two-wire 250 volt system, with motor balancer set for obtaining 125 volts for variable speed motors was adopted on account of its simplicity, the saving in first cost in motors and wiring, its better efficiency, and the fact that standard motors and generators could be used throughout. The current will be supplied by two engine-driven 250 volt generators, one 250 Kw., 150 R P.M, and the other 500 Kw., 130 R.P.M.

By means of a balancer set, 115 volt current will be supplied for lighting and 115-230 volts for motors.

Twenty-six variable speed motors, types CE, CL and CK, aggregating 325 H.P., and ranging in sizes from 5 to 30 H.P., will be installed with the first equipment.

A speed range of 4 to 1 will be obtained by means of the double voltage, 115–230, the motors being capable of 100 per cent. field control, armature resistance being used only in starting.

In addition to these variable speed motors, about the same capacity in constant speed machines will be used for driving groups of tools.

An interesting feature of this installation will be the operation of a pumping plant some 8000 ft. from the generating station. Through a 50 Kw. inverted rotary and a 3-phase step-up transformer, 250 volts D. C. will be converted to 2300 volts, 25 cycles A. C., and delivered to a 50 H P., 2080 volt motor, which will be geared to the pump.

## TRANSFORMERS

### TYPE H TRANSFORMERS

The fact that nearly all of the transformer manufacturers in this country are imitating, in one way or another, Type H

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Transformers speaks well for the General Electric Company's apparatus.

Each year brings forth some noted improvement in General Electric transformers, and our Engineers have been able to keep the Type H well in the lead of all transformers of similar make.

The introduction of the Type H transformer permits of:

1st. The adoption of windings of such construction as to render possible the effective use of mica between primary and secondary.

2nd. The use of windings so arranged as to keep all parts of the copper in close proximity to the oil, thereby preventing "hot spots."

3rd. The use of non-aging iron and insulations.

4th. The use of balanced windings for three-wire distribution.

5th. The introduction of our "Vacuum Drying and Compound Filling Process."

6th. The adoption of "U" shaped punchings, which minimize the number of joints in the magnetic circuit.

7th. The use of separately wound and subdivided coils to facilitate construction and to reduce the voltage strain between layers.

## WATTMETERS

### THE TRINIDAD ELECTRIC COMPANY, Trinidad, B. W. I.

The above company has been considering the purchase of a considerable number of alternating current meters to replace a similar number of obsolete meters.

After carefully considering the matter a trial order for 25 high torque induction meters was placed with the General Electric Company. These meters, together with all similar meters upon the market, were tested under the most adverse conditions, and as a result orders were placed with us for 250 high torque meters, which clearly proved the superiority of General Electric Company meters.

## GENERATING SETS

### MARINE SETS

That our combined engine and generator sets are not limited to marine use, is shown by an interesting installation recently made by the Towle Manufacturing Company, Newburyport, Mass., the oldest firm of silversmiths in this country.

This set is of 50 Kw. capacity, the engine being of the vertical single-cylinder type. Owing to the small space available in their engine room, it was necessary to install a set occupying a minimum of floor space, and our machines were chosen principally for their adaptability in this respect.

Another feature of this plant is that night work may be done without starting the large main engine, as the lighting set is of course entirely independent of the other machinery.

Some recent sales of marine apparatus are as follows:

New Bedford, Martha's Vineyard & Nantucket Steamboat Company's Steamer, "Gay Head," one 15 Kw., 110 volt generator and engine, switchboard and 13″ searchlight.

Nantasket Steamboat Company, Steamer "Nantasket," 15 Kw. set, switchboard and 13″ searchlight.

Nantasket Steamboat Company, Steamer, (not named yet), 15 Kw. set, switchboard and 13″ searchlight.

Steam Yacht "Carmina" built by Lawley, Boston, one 10 Kw. marine generator and 13″ searchlight.

Steam Yacht "Calumet" built by Lawley, one 7 Kw. marine generator and 13″ searchlight.

Steam yacht owned by W. B. Smith, Whaley, 4 Kw. generator, and 9″ light.

Tug "W. A. Clark," Columbia, South Carolina, 20 Kw. marine generator and engine with 24″ light.

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## MISCELLANEOUS

### A REMARKABLE TESTIMONIAL

Before the late South African war there were installed in the Knights Deep Mine, in Johannesburg, twelve three-phase, 50 H.P., slow speed, induction motors, and thirty-six 15 Kw., Type H, General Electric transformers, operating pumps. When the war broke out, it was found impossible to remove the pumps, motors and transformers before allowing the shaft to fill up with water and consequently they were left under between 500 and 1000 feet of water. Two and one-half years later, when peace was declared, that is, a little over a year ago, the shaft was unwatered and the apparatus removed to the surface. Three of these were completely rewound in our Johannesburg repair shop, but the others were simply dried out in an oven heated by steam coils and were then soaked in oil. This was done as an experiment to see whether the insulation had perished, and, contrary to expectations, it was found that these motors had not suffered during the two and one-half years under water sufficiently to make it necessary to rewind them, and they were put back into service after having undergone the treatment mentioned.

Then the Type H transformers which had been under water were treated in the same way, and it was found that they also did not need rewinding. Shortly after some of them were put back, six out of nine 50 Kw. transformers of English manufacture, which had never been in service and which were new, burned out just after having been installed. These new transformers were promptly replaced by an equivalent number of General Electric transformers which had been under water and which operated satisfactorily under the same conditions that the transformers of other make burned out. We have just received a cable order for nine 50 Kw. transformers to replace all of those furnished by our competitors.

### NEW OFFICES

On or about September 1st, the Boston office will move to its new quarters in the India building, corner State street and Merchants' Row. This is new and modern office building in the heart of the financial district, and the General Electric company will occupy the entire seventh floor.

### TRANSPORTING TROOPS BY TROLLEY

An interesting experiment has just been made by the officers of the second brigade M. V. M. in connection with the annual muster at So. Framington. The ninth regiment with headquarters at Boston will be taken to the camp in special cars of the newly opened Boston & Worcester St. Ry. The men will be taken aboard at their armory on the East Newton Street and conveyed directly to the camp without change, a special trolley car carrying all the baggage in advance of the troop cars.

This road uses General Electric apparatus throughout, with Type M control on the cars, and the equipment has given complete satisfaction from the start.

### POWER HOUSE UNDER WATER

The following is a letter received by the General Electric Company from the General Manager of one of the companies which was inundated by the recent Mississippi flood:

MY DEAR MR. SUNNY:

"I thank you for your letter which reached me a day or two ago. No one who was not here to see the flood, and then see the mud and sand left on our machines and filled into every crack and crevice and every switch and device in our basement, and for the most part our engine room floor, can realize in what condition we were left.

"Mr. Lewis has been of the greatest help to us, and I think that we have not only made a record for ourselves, but a record for the General Electric apparatus. Our two big 1500 Kw., 6600 volt generators were more than half under water for a week, and within a week from the time the water went down below the machines we had one running, pulling the railroad and two days after, the second one. It looks as though all of our other machinery was going to come out all right, but of course it takes considerable time to dry them out, particularly as we are very short of power, and therefore have not what we would like to use in the way of drying out machines.

"I thank you for the kind expressions in your letter, also for similar letters received from Mr. Boyer and Mr. Scribner, in fact the General Electric Company at large."

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# General Electric Company Review, September, 1903.

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# GENERAL ELECTRIC COMPANY REVIEW

VOL. I SCHENECTADY, N. Y., SEPTEMBER, 1903 No. 5

GENERAL ELECTRIC COMPANY REVIEW

The REVIEW is published monthly for the information of officers and employees of the General Electric Company only.

MARTIN P. RICE, - - - - - *Editor.*
EDMUND P. WALLER, - - - *Ass't Editor.*
CARYL D. HASKINS, - *Commercial Conferee.*

News items and contributed articles for the issue of any month must reach the Publication Bureau by the twentieth of the preceding month.

Good photographs can be readily reproduced in the REVIEW and frequently add to the value of descriptive articles.

## NEW ELECTRIC LOCOMOTIVES FOR B. & O. RAILWAY CO.

The most powerful locomotives in the world have just been built by the General Electric Company at Schenectady, for the Baltimore & Ohio Railroad for use in its tunnel underneath the city of Baltimore. These locomotives mark a very distinct advance in electric locomotive design. They will handle the freight traffic of the Baltimore & Ohio which passes through Baltimore, and will operate over the same section as the present electric locomotives built by the General Electric Company, which have been in successful operation for the past eight years.

The specifications called for electric locomotives capable of hauling a 1500 ton train, including the steam locomotive but excluding the electric locomotive, on a maximum grade of 1½ per cent at nine miles per hour with corresponding higher speed on lighter grades. The electric locomotive weighs 162 tons on the drivers. The engineers of the General Electric Company decided that the most practicable scheme was to built a locomotive consisting of two units operated together as one locomotive by means of the Sprague-General Electric Multiple Unit Control.

The section of the road to be operated runs from Camden Street Station through the tunnel to the summit of the grade outside the tunnel, a distance of 3½ miles.

Under practical operating conditions the motors have sufficient capacity to maintain this service hourly, running loaded up the grade and returning light.

On account of the simplicity, accessibility and minimum number of wearing parts, it is believed that the maintenance account of this locomotive will be very low. All wearing surfaces have been made large for the purpose of insuring long life. At the same time, special provision has been made for their easy replacement whenever it becomes necessary. There is a large space under the cab floor in which a man can stand and inspect the motors or truck gear.

The locomotive is equipped with eight GE-65 motors, four on each half. These motors have a capacity of 200 H.P., each, making a total capacity of 1600 H.P. These motors are designed with a very liberal margin and are capable of standing very heavy overloads for short periods. The capacity of this locomotive to pull is tremendous. As a matter

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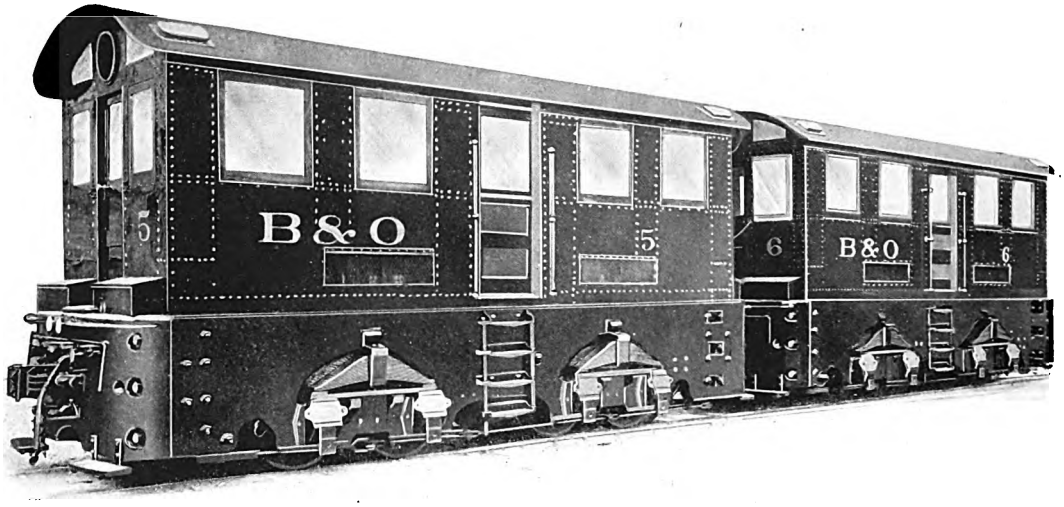


Complete B. & O. Locomotive

of comparison our largest steam locomotives are only capable of developing at a maximum about 1500 H.P. For example, some tests were recently made on one of the New York Central's latest type of locomotive hauling the Empire State Express at a high rate of speed, and the indicator cards taken showed that the locomotive developed at its maximum about 1500 H.P.

The main body of the truck frame consists of a rectangular framework of cast steel built up of four pieces, two side frames and two end frames, made strong and heavy. The parts are machined at the ends and securely fitted and bolted together, thus forming a very strong and rigid structure capable of withstanding without injury the most severe shocks.

The end pieces form the buffer beams and to these a suitable standard draft gear of approved design is attached. This draft gear is deserving of special attention as it involves some very novel features. The gear is designed to withstand a maximum draw bar pull of approximately 100,000 lbs. which the locomotives are capable of exerting under the best conditions. One of the standard draft gears on the market was purchased and in addition to its ordinary movement the General Electric Company has provided on these locomotives a certain amount of lateral movement governed by heavy springs, this movement being desirable on sharp curves.

The side frames have machined jaws protected by wearing shoes between which the journal boxes slide.

The truck frames are supported at four points on equalizers. Each equalizer rests on a pair of half-elliptic springs, the ends of which are supported on top of the journal boxes through suitable wearing plates. This construction forms a simple and effective arrangement of parts.

The journal boxes are made quite similar to standard car journal boxes; the parts, however, are made larger and stronger. The brasses can be easily removed and by dropping down the wearing shoes it is possible to remove a journal box complete without removing the wheels and axles or other parts of the truck.

In order that the locomotive may round curves easily, the axles are permitted considerable lateral movement in the journal boxes, it being practical to do this with this design of electric locomotive and thus reduce the effective rigid wheel base.

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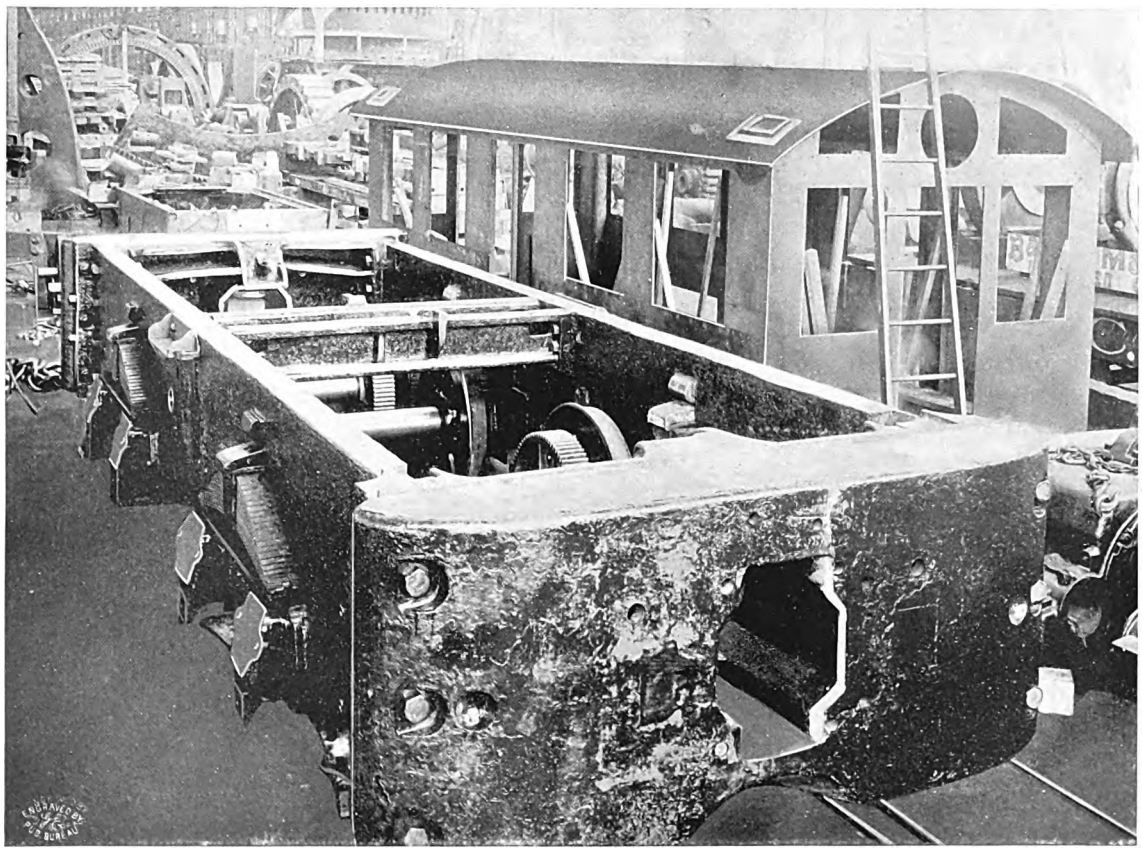
Wheels, axles or motors may be easily removed from the trucks by dropping into a suitably constructed pit or by raising the truck frame.

The locomotive has sixteen steel-tired spoked wheels. The tires are 2⅞″ thick with M. C. B. standard tread and flange and are securely held in place by improved fastenings. The axles are made of forged steel turned throughout, 6″ x 12″ in the truck journal bearings, 8″ in the wheel fit and 7½″ in the motor bearings.

communication between locomotives when coupled together. Large windows afford a practically unobstructed view in all directions.

The controlling apparatus consisting of master controller, engineer's valves, etc., is in duplicate, a complete set being located in diagonally opposite corners of the cab so that the engineer when it suits his convenience can stand in the front end of the locomotive when running in either direction.

The locomotive is equipped with bell, whistle, locomotive headlights, improved air



**Frame and Cab of B. & O. Locomotive**

The cab is large and roomy. The floor rests on the truck frame. The lining floor is made of 1¾″ hard pine, tongued and grooved; the upper floor is of maple ⅞″ thick, tongued and grooved and laid in the opposite direction from the lining floor.

The sides and roof of the cab are made of sheet steel. On each side there is an entrance door, and at each end there is an additional door which permits of ready

brake mechanism including engineer's valves and air gauges, necessary brake cylinders, foundation brake, air reservoirs, couplers and draw heads. Also pneumatic track sanders.

The first locomotive has been shipped and is now at Baltimore, and will probably be put into service shortly. The second locomotive is now under construction, and will probably be shipped sometime in September.

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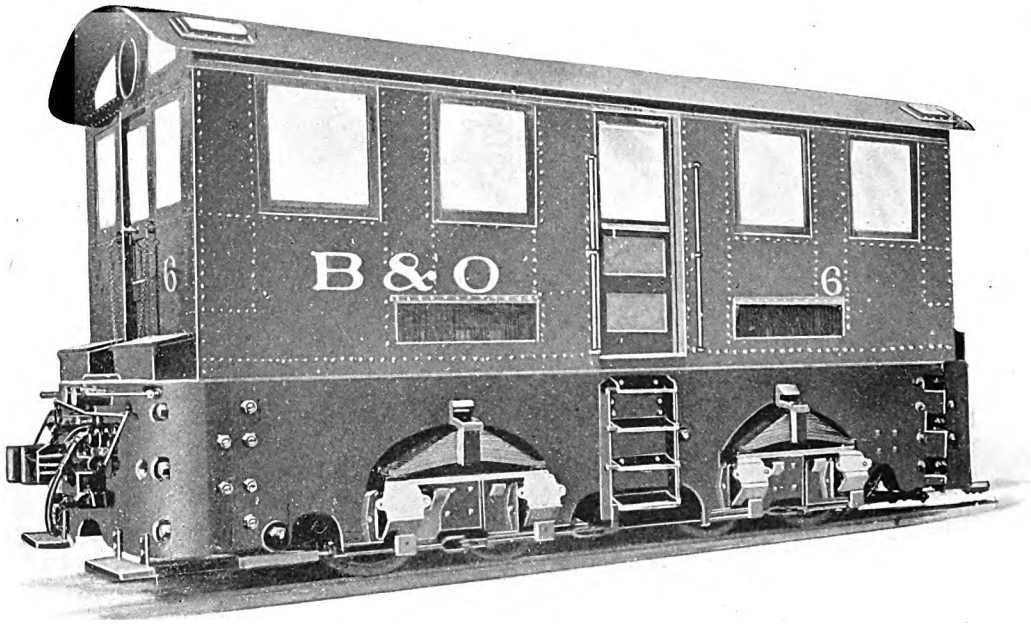
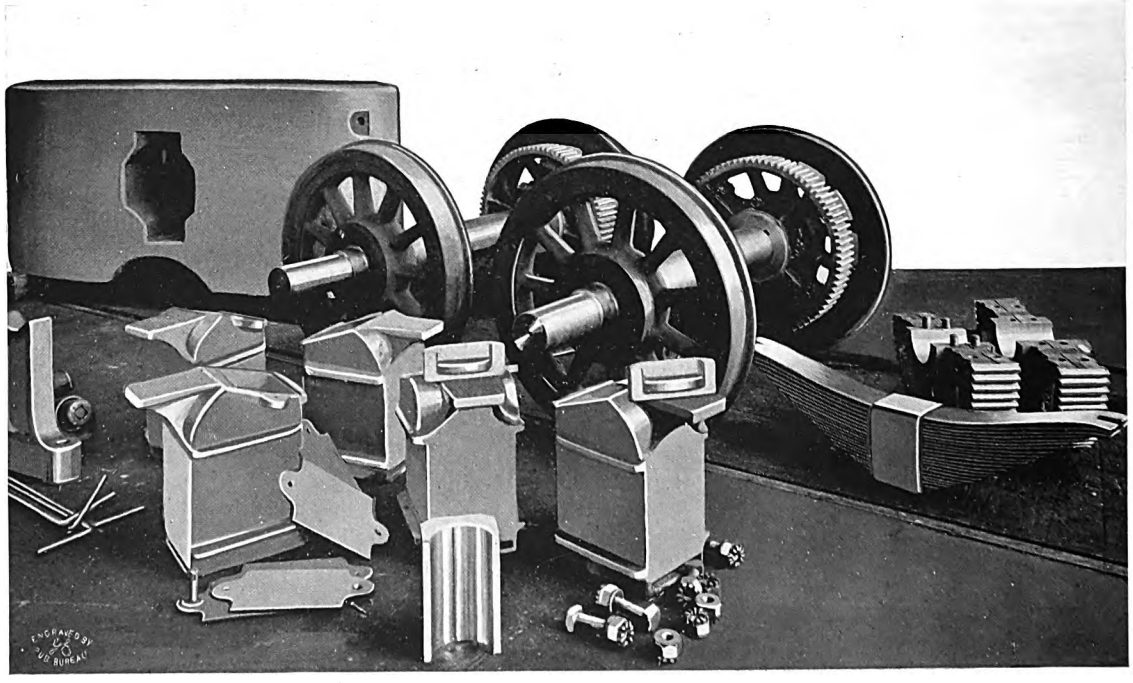



**Single Unit of B. & O. Locomotive**



**Parts of B. & O. Locomotive**

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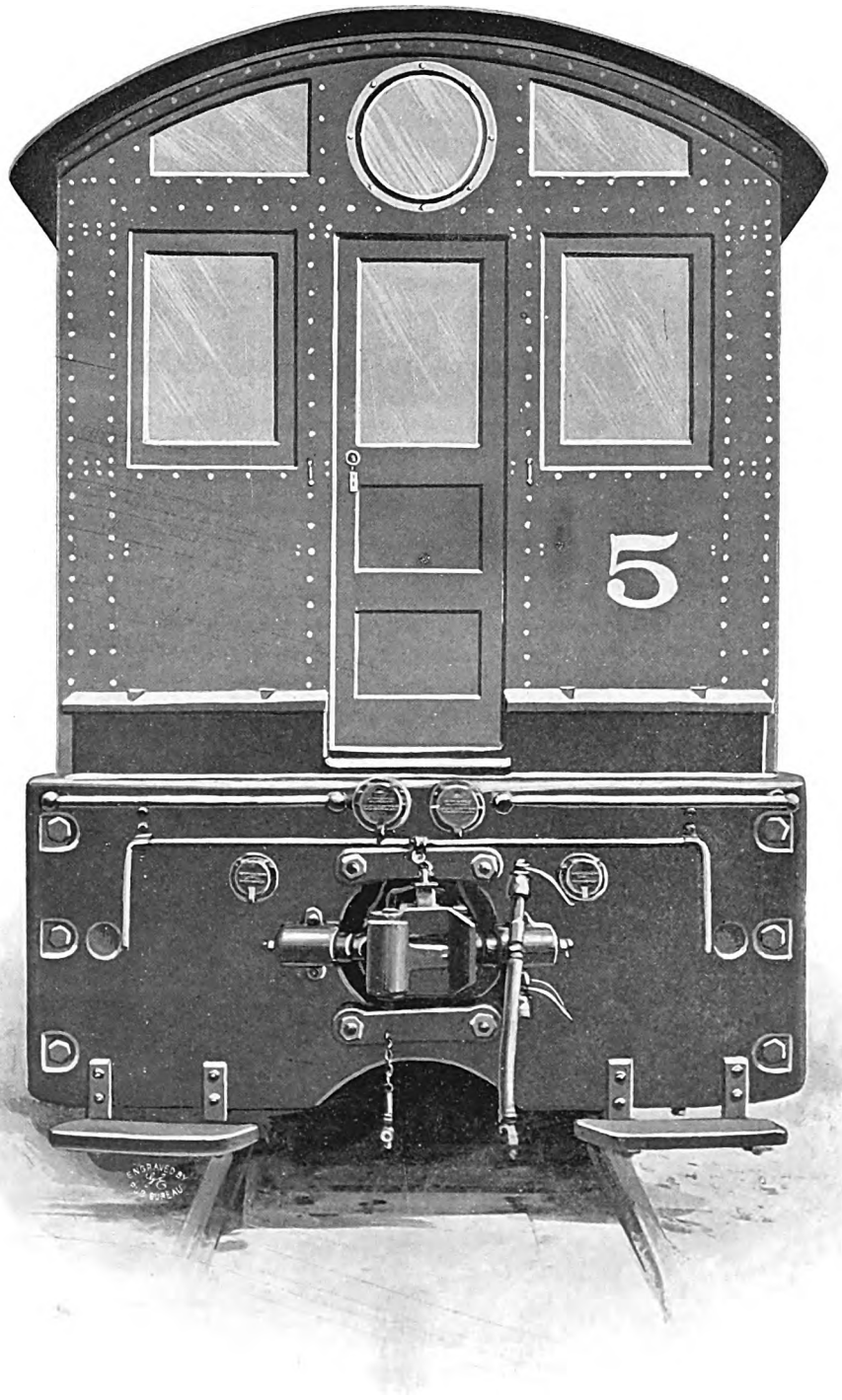


**End View of B. & O. Locomotive**

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# RAILWAY

### THE SAGINAW VALLEY TRACTION COMPANY,

**Saginaw, Mich.**

This company is the consolidation of the following companies:

The Saginaw Valley Traction Co., Saginaw, Mich.

The Bartlett Illuminating Co., Saginaw, Mich.

The Bay City Consolidated St. Ry. Co., Bay City, Mich.

The Bay City Gas Co., Bay City, Mich.

A new plant will be built at Saginaw to supply current for electric lighting and the railway and power circuits in Saginaw and the interurban line between Saginaw and Bay City, and to combine the power station of the Bay City Gas Co. and the Consolidated St. Ry. Co. in the power house now operated by the Bay City Consolidated Street Railway Co.

In making these changes very little of the old apparatus will be used, the installation will be modern and up-to-date. The new apparatus in the Saginaw power house will consist of:

One 1000 Kw., 575 volt engine type railway generator.

One 500 Kw., 60 cycle, 2300 volt, 3-phase Curtis turbo unit.

One 35 Kw. motor-driven exciter set.

One 30 Kw, engine-driven exciter set.

One 300 Kw., 2300 volt, 3-phase belted generator.

One 450 Kw. motor-generator set.

One 200 H P., 2300 volt induction motor.

One Type TA automatic potential regulator.

Eleven new panels for the switchboard.

The Bay City plant has the following new apparatus:

One 500 Kw., 60 cycle, 2300 volt, 3-phase Curtis turbo unit.

One 350 Kw. motor-generator set.

One 35 Kw. motor-driven exciter set.

One 30 Kw. engine-driven exciter set.

One 150 H.P., 2300 volt induction motor.

One Type TA automatic potential regulator.

Fourteen new panels for switchboard.

For the combined railways there have been added:

Five Double GE-67 motor equipments.

Three 4 motor GE-67 equipments.

In the near future quite a large number of additional equipments will be put in.

### INTERBOROUGH RAPID TRANSIT COMPANY,

**New York, N. Y.**

The following clipping from the New York Times of Aug. 14th regarding the operating expenses of the Manhattan Railway Co. operated by the Interborough Rapid Transit Company is of interest as showing a large saving due to the substitution of electrical equipment.

The description of this equipment has been set forth in the July and August numbers of the REVIEW.

**Interborough Report,**
**Operating Cost for Quarter Ended June 30**
**Smallest on Record**

Special to the New York Times.

Albany, N. Y. Aug. 13.—The Interborough Railroad Company made a record in operating the system of railroads it controls during the quarter ended June 30. The operating cost for that quarter is the smallest ever known in the conduct of railroads in this country, and demonstrates the cheapness of electricity as a motive power.

The operating cost for the quarter, excluding taxes, was 39.80 per cent and including taxes, 46.91 per cent. During only a brief period, after April 1, when the Interborough Company took charge of the Manhattan Elevated, a few locomotives were used. Therefore the road may be said practically to have been operated by electricity for the whole quarter.

For the corresponding quarter last year, when the motive power was part steam and part electricity, the operating cost was 49.03 per cent. excluding taxes, and 56.18 per cent. including taxes.

For the quarter ended June 30, 1901, when the entire system was operated by steam, the operating cost was 53.12 per cent. excluding taxes.

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# LIGHTING

## MERIDIAN LAMPS

The supply department of our New York Office recently acquired more commodious quarters and although the new space is naturally dark due to the small number of windows and the close proximity of tall buildings, it has not only been made available by the use of Meridian lamps but in a manner which would have been impossible with other artificial illuminants without a much greater expenditure of energy.

The following facts regarding the installation will be of interest. The office is divided into four rooms and each has a different amount of illumination as is set forth in the following table: The lamps are placed in our standard receptacles, Cat. No. 50785, fastened to the ceiling and are 9′ 7″ from the floor or 7′ from the surface of the desks to be illuminated.

| Room No. | Square Feet. | No. Lamps. | Total Watts. | Watts per Square Ft. | Approximate average illumination in Square Feet on desks. | No. Occupants. | Watts used by Old Method. | Saving over Old Method. |
|---|---|---|---|---|---|---|---|---|
| 1 | 562 | 9 | 1080 | 1.93 | 3 | 5 | 1800 | 40% |
| 2 | 457 | 8 | 960 | 2.1 | 3.25 | 9 | 1500 | 37% |
| 3 | 1016 | 13 | 1560 | 1.54 | 2.25 | 16 | 2400 | 35% |
| 4 | 395 | 6 | 720 | 1.83 | 2.75 | 7 | 900 | 20% |

The old method of lighting consisted of three-light clusters fastened to the ceiling, each socket carrying a 32 C. P. incandescent lamp. There was also an occasional two or four-light electrolier. By using Meridian Lamps not only large economies are effected but the light is much more evenly distributed so that every foot of the space is available.

The illumination of room No. 3 is satisfactory now as considerable daylight filters in but it may be necessary to add more lamps when we have to depend on artificial light entirely. Room No. 2 has no windows whatever and the illumination is entirely satisfactory.

## EXCELSIOR SPRINGS LIGHT, POWER, HEAT AND WATER COMPANY

**Excelsior Springs, Mo.**

The power plant of the Excelsior Springs Light, Power, Heat and Water Company, Excelsior Springs, Mo., has just started into operation, and everything works very satisfactorily.

This plant consists of two 75 Kw., 250 volt compound-wound generators, operated on the Edison 3-wire system, 110 volts between neutral and outside and 220 volts between outside wires. They have installed in connection with the above generators one balancer set consisting of two CE 11 Kw., 125 volt balancers; and we have also furnished them a booster set consisting of one 5 Kw., 230 volt shunt-wound motor and two 60 volt, 80 ampere boosters, all mounted on a common base. The latter is to charge a set of chloride accumulators, which are used for supplying current during the daytime, thus giving practically continuous service with the plant operating only during the heavy portion of the lighting load. For the street lighting 220 volt twin carbon arc lamps are used.

This type of the Edison 3-wire direct-current plant is somewhat unusual, using generators entirely on the outside wires and balancers for taking care of the neutral.

## CLOTHING STORE

**A. L. Netting, Pittsburg, Pa.**

The store of A. L. Netting, Pittsburg, Pa., is lighted with Meridian lamps, and he is greatly pleased with the results. He says he thinks his store was never so well lighted as it is at present. This store is about 21 ft. wide and and 100 ft. deep. The lamps are screwed into the receptacles on the ceiling and are about 11 ft. from the floor. The counters consist largely of the latest form of show cases, made entirely of plate glass, and the Meridian light placed on the ceiling above gives ample illumination to show the stock of

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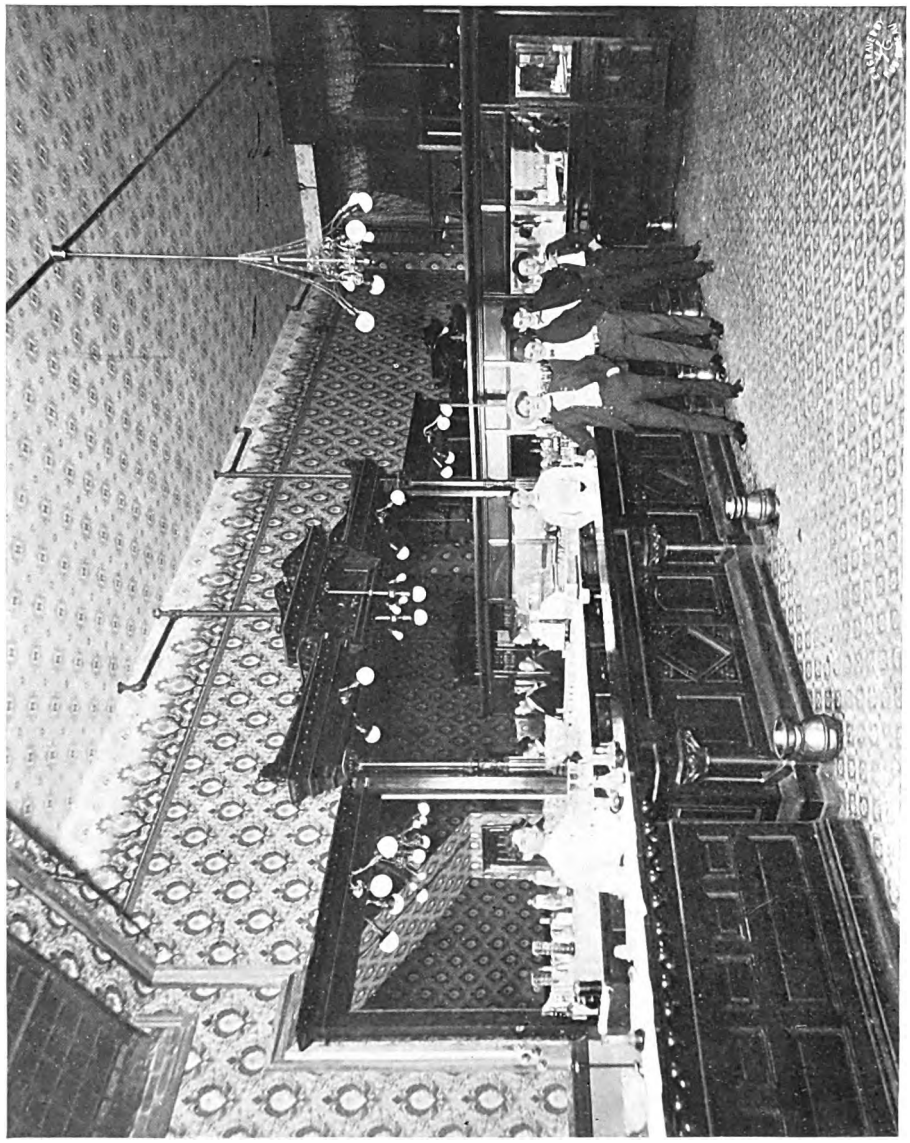

Meridian Lamp Installation in Saloon

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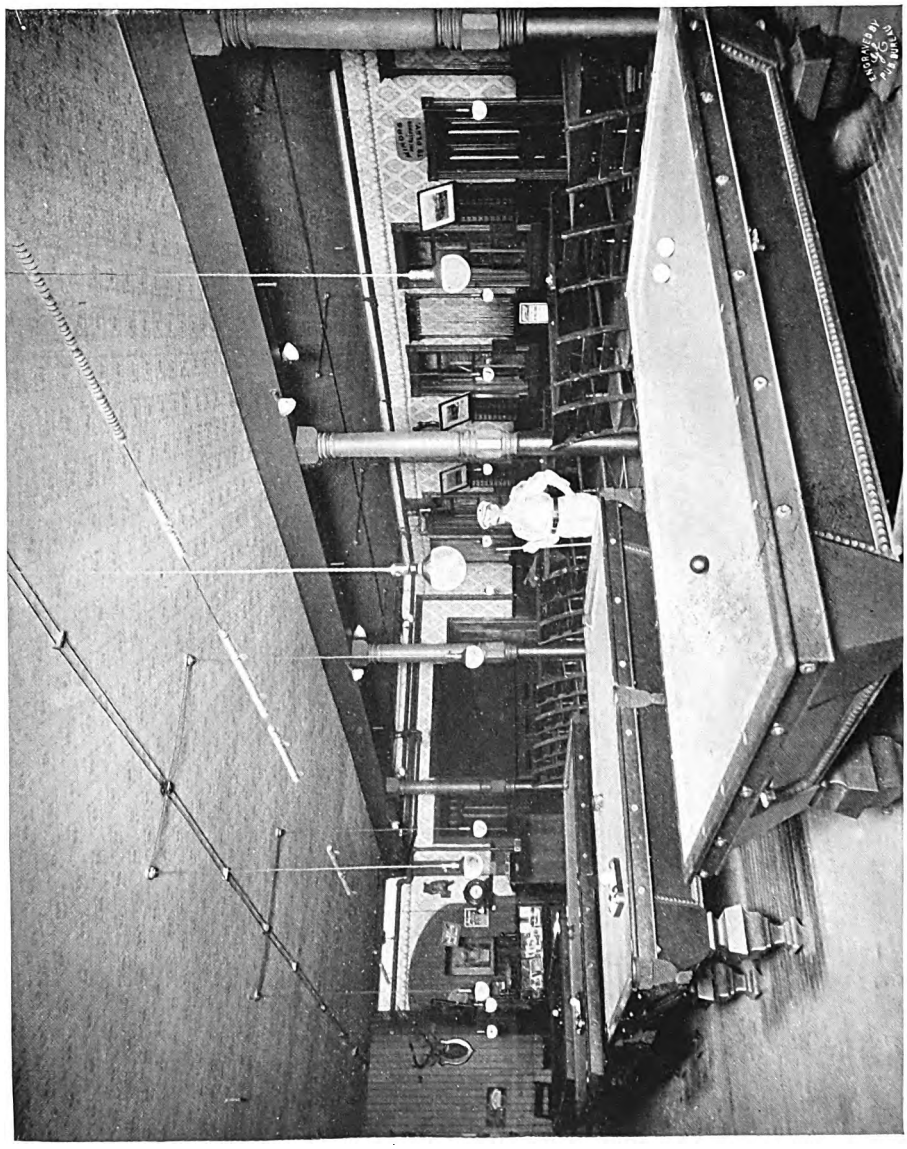

**Meridian Lamp Installation in Billiard Parlor**

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men's shirts, hosiery, neckwear, etc., in an ideal manner. In this class of goods the shades of color are all important and the light must be perfect to enable the customer to make a satisfactory selection.

**NEWBURGH LIGHT, HEAT AND POWER COMPANY**
**Newburgh, N. Y.**

The above parties are adding to their central station equipment by ordering from us a 400 Kw., 2300 volt, two-phase, belt-driven generator, this being in addition to the 300 Kw., belt-driven generator of the same type recently installed.

**AMERICAN MUSEUM OF NATURAL HISTORY**
**Manhattan Square, New York**

The above institution is increasing its electrical plant by the addition of two 200 Kw., 250 volt generators, to be direct connected to Corliss engines.

These generators are arranged so that at any subsequent time collector rings and compensators may be added so that they may be available for use as three-wire generators.

For temporarily supplying the three-wire system two of the present Edison bipolar generators are to be direct coupled and operated as a balancer set in the usual way.

**EDISON ELECTRIC ILLUMINATING COMPANY**
**Pottsville, Pa.**

The above company has ordered from the General Electric Company two 300 Kw., 250 volt, six-phase rotary converters, which are furnished with pulleys, and arranged for operating either as double current generators at 200 Kw. or as rotary converters at 300 Kw.

At present they will be used as double current machines, supplying current to the local three-wire system and stepping up through transformers to 2300 volts for more distant distribution.

It is the ultimate intention to install a 25 cycle generating station in the event of which the rotaries will be used to transform the alternating current into 250 volt current for the 3-wire system.

**THE EDISON ELECTRIC LIGHT COMPANY**
**York, Pa.**

The General Electric Company has lately closed a contract with the Edison Electric Light Company, York, Pa., for a complete station equipment; the power is received from the York Haven Water and Power Company's development at York Haven, which is about 12 miles away. A sub-station at the city limits of York receives the power at 24,000 volts which is here stepped down to 2400 volts. The power will be delivered to the Edison Electric Light Company at 2300 volts at the receiving panel. There it will divide, part of it going to the lighting and part to the ring section of a new switchboard consisting of 31 panels.

At present the station is engine operated direct connected to line shafting from which the various machines are driven.

The new equipment calls for 580 H.P. and 300 H.P. induction motors for operating the generators furnishing current to the Edison 3-wire system.

The alternating current distribution will be taken care of direct through single and three-phase feeder panels at 2300 volts, the receiving voltage.

The Brush arc machines will be direct connected to synchronous motors, each motor driving two machines.

The railway generators will be replaced by rotary converters with motor operated dial switches, and air blast transformers.

Part of the steam outfit will be maintained to operate supplementary generators which may be used either for lighting the Edison 3-wire mains or in series on the ring system.

The switchboard will be mounted on a gallery and will consist of 31 panels with necessary instruments, meters, switches, etc., for controlling the operation of the various machines.

One sub station will be installed at present equipped with rotary converters and receiving current through the main station at 24,000 volts. The installation includes all necessary transformers, regulators, switchboard, etc.

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# POWER APPLICATIONS

## ELECTRIC DRIVE

**International Harvester Company**
**Chicago, Ill.**

The three-phase power plant at the Deering Division of the International Harvester Company, one of the pioneers in electric drive, ranks among the largest in the country.

In 1897 this company decided to use induction motors in an extension of its twine factory, on account of economy of operation, safety from fire and reliability of service. The experience was so satisfactory with this installation that it was decided in the following year to build a central power station and equip the entire plant electrically.

The present alternating equipment consists of:

One 750 Kw., 100-600 volt; one 750 Kw., 92.5-600 volt; and two 1100 Kw., 9.25-600 volt, engine-driven, 40 cycle generators with exciters and switchboards; also a complement of a 300 H.P. synchronous motor, and about 4000 H.P. of induction motors in sizes of from 10 H.P. to 100 H.P.

This company has also 600 H.P. of 220 volt direct current motors for certain classes of work, such as elevators, cranes, trolley service, etc., and the statement has been made by representatives of the Harvester Company that it costs no more to maintain the large capacity in alternating current apparatus than it does the comparatively small capacity of direct current apparatus.

An interesting test recently completed in the twine mills of this plant serves as a good illustration of the advantages of individually direct driven machinery. There are in this department about 1300 spindles or flyers, two of which are mounted horizontally on one suitable frame and form a spinning machine. About one-half the spinning machines are driven from shafting direct from engine room, the remainder being belt-driven by 75 H.P., 40 cycle induction motors in groups of sixty-eight.

About 18,000 feet of 3″ belting would be required for driving 650 spindles, and it is evident that the use of a direct connected motor with each spindle, thereby doing away with belting, as now required, together with necessary shafting and gearing, should effect something of a saving in power and maintenance.

The test referred to was very carefully made, the General Electric Co. having furnished for the purpose one of its 1 H.P., 1200 R.P.M., 3-phase induction motors. The tests show that the power required at the motor to operate the spindle or flyer, to which it was direct connected, was .808 Kw. The power required to operate the spindle when driven in group from the 75 H.P. motor was 1.05 Kw. Assuming 650 spindles so equipped, the saving in power would be, according to estimates of the Deering people, $8,720.00 per annum, their figures being based on a cost of power at the motor of 1½c. per Kw.-hour, including power plant fixed charges. The fixed charges for the individual drive will be greater, as an investment necessary to equip 650 spindles with individual motors will be required.

The Deering people have been exceedingly conservative in their estimate of these fixed charges, as indicated by their figuring the depreciation on the motors at 7% as against 10% on shafting, belts, etc. They also figure conservatively on labor, charging against the individual motors $2.00 per motor per annum and $15 00 for group drive motor per annum for maintenance. They also charge against the individual drive the same amount for labor, machinists and oilers that they charge against the group drive, although the elimination of the long lines of shafting would be expected to make a substantial saving in this connection. Notwithstanding this conservative figuring they concede a net saving for individual drive of $2,225.00 per annum after taking taxes, insurance, depreciation, interest, maintenance and labor into account. The Deering Co. claims its figures would apply, however, only on a new installation. To change from the group motor drive or engine drive to the individual motor flyer drive would

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call for other items of expense against the individual motor drive,—that is, loss of shafting, belts, pulleys, hangers, etc., now in use, and expense of readjusting spinning machines. These figures are made up from the test of one motor only applied directly to a single spinning flyer, as noted. Whether this particular method of individual motor application, as noted here in this instance, would finally be considered best, is a question not yet fully determined. It will no doubt take some further engineering. The Deering people are inclined to believe that the same good showing might be obtained without the use of so many small motors and still have a direct connected drive, doing away with all belting and shafting. They concede the following advantages for the individual motor:

First. Saving in power by eliminating the very heavy system of shafting and belts.

Second. Better sanitary conditions and health of operatives.

Third. Better insurance conditions.

Fourth. Reduced wear and tear on buildings.

Fifth. Presumably more product output per given floor area.

In addition to these advantages might be mentioned the following:

Better light.

Increased efficiency of the individual motor drive as compared with the efficiency of the group drive when only part of the machines are running.

Permanent additions with pro rata outlay of capital.

While the Deering people insist that the item of maintenance cost must not be minimized and that motor depreciation should not go in at less than 7%, nevertheless if the depreciation on motors is figured at 2% instead of 7% and three oilers are omitted (eight being provided for in the Deering Company's estimate), the saving would be about $7,800.00 per annum instead of $2,225.00.

## ELECTRICALLY EQUIPPED PAINT FACTORY

### W. P. Fuller & Co.

W. P. Fuller & Company have for some years operated electrically their paint factories near South San Francisco, Cal., and a brief description is given herewith:

The engine room is 30 x 60 ft., the floor being covered with tiles, the walls also being tiled to a height of 5 feet, and the ceiling is of paneled red wood, the walls being tinted to correspond. All indicating and recording gauges for the engine are mounted on a mirror 4 x 6 feet. The engine was built by the E. P. Allis Company, being the Corliss cross compound type and is direct connected to a 200 Kw, 500 volt, 40 cycle, revolving field generator operating at 100 R.P.M. Belted from the main shaft is a 13½ Kw., 125 volt exciter.

The switchboard consists of two marble panels, one for the generator and exciter with necessary instruments, etc., the other for six feeder circuits.

Fourteen 440 volt, three-phase induction motors, aggregating 320 H.P., have been installed, each motor being equipped with a starting compensator.

These motors, wherever possible, are belted to jack-shafts with clutch pulleys to permit of starting with no load. They are used to operate the various mills, grinders, mixers, elevators, conveyors, etc., used in the manufacture of various paint products. Some of the special applications are as follows:

In one department pig lead is melted into furnaces and run out in several continuous streams upon moving forms which are attached to endless chains. As the castings become cool they are automatically knocked out of the forms, which give them the shape of grids, called "buckles," presenting a large surface to be attacked in the process of making white lead. These buckles are conveyed to cooling bins from which they are carried to the department where the next step in the process takes place. One of the 50 H.P. motors is used to drive a 52 inch millstone for grinding. One of the smaller motors is

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mounted on a portable truck which can be easily hauled about from place to place, and belted to any device desirable. This is used especially for operating a conveyor which lifts great quantities of tan bark from piles on the floor into various bins. One of the 10 H.P. motors has also been used on a dredge at the company's dock near the buildings. While this plant is not one of our very recent installations, the fact that it has been run practically continuously since January 15th, 1899, with entire satisfaction to the owners, is worthy of note.

One of the 50 H.P. motors has been accidentally subjected to an overload of 200 per cent without injury. The generator which is rated as giving 231 amperes has withstood heavy overloads at times without serious results. Not one cent has been expended for repairs, on the plant since its installation, and all apparatus is in first-class operating condition. The 10 H.P. motor which was used for dredging at one time, fell overboard into the mud and salt water. It was hoisted out, washed off, dried out and put into operation again with satisfactory results.

### ELECTRICALLY DRIVEN COAL HANDLING MACHINERY

**Northwestern Fuel Co., West Superior, Wis.**

One of the most unique and interesting applications of electric motors for special work is in their application to coal handling machinery of the Northwestern Coal Company at their West Superior, Wis., dock. There are four tall towers that move laterally on rails along the dock. Each tower has a one ton bucket that travels on a long inclined ram supported by the tower. The coal is taken in from the hold of the vessel by these one ton buckets and hoisted vertically for about 50 feet; then it is racked in obliquely and deposited in the hopper. The slide of the hopper is opened and closed by a small motor.

The time required for the hoisting bucket to make one round trip, from hold of vessel to hopper is about thirty seconds. As the bucket returns from the highest point by gravity, the power is required only in periods of about fifteen seconds.

The power required to operate each tower is about 185 H.P., one of our MP 185 H.P., 220 volt direct current series motors being used.

From the hopper, which is stationary, the coal descends by gravity into a seven ton bucket, which is suspended from a trolley and which, when loaded, is moved along the dock until it is aligned with a bridge extending across the dock. The trolley car with the seven ton bucket suspended is then run onto the bridge and the coal is transferred either to a pile on the dock or is run to the further side of the dock and the coal emptied into bins, from which it is loaded into cars. The arrangement is such that the hoppers are loaded at the same rate at which they can be unloaded by the buckets suspended from the cars.

These bridges, of which there are three, can also be moved along the dock and their positions changed as required. The transfers, trolleys and bridges are all operated by our 220 volt railway type motors.

This dock when completed will be the largest in the world, and the equipment is a new departure in the field of coal handling. All of the motors, generators and other electrical apparatus are of General Electric make. The power to operate these motors is furnished by three 200 Kw., 250 volt, compound wound, engine-driven generators.

We are informed by Mr. G. H. Hutchinson, the chief engineer of this company, that this installation is a complete success and that the economy is greater than with any other method. They are more than pleased with the ease and flexibility with which the motors operate the machinery.

### DUPONT POWDER COMPANY

**Birmingham, Ala.**

The General Electric Company has just closed a contract with the Dupont Powder Company for all necessary machinery to operate the powder mills at Birmingham,

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Ala. The contract covers two 200 Kw., belt-driven, 550 volt, compound wound generators, and the following motors:

One 85 H.P, one 70 H.P., seven 35 H P. and three 10 H.P.

These motors will be used to drive wheel mills, pulverizers, mixers, glazers, hydraulic power pumps and like machinery found in mills of this sort. The pulverizers and glazers will be grouped in batteries and geared to a common line shaft which in turn will be geared to and driven by a single motor. The wheel mills and most of the other machinery will have individual drives.

Machinery of this type requires an excessive amount of power to start and accelerate to full speed, prohibiting the use of standard shunt wound motors, and in order to produce the abnormal starting torque required all of the motors will be furnished with special compound wound field coils. Wherever possible the motors will be placed in bomb-proof structures separated from the main building by brick walls and special non-arcing starting devices used in order to minimize the danger of explosions.

### EQUIPMENT FOR SCRANTON SHOPS OF THE DELAWARE, LACKAWANNA & WESTERN R. R. CO.

The above company has placed an order with us for power equipment for its shops at Keyser Valley, Scranton, Pa.

The generating plant will consist of three direct connected 60 cycle, 3-phase generators, two of 300 Kw. at 225 R P.M., and one of 100 Kw. at 257 R P.M. The generators are to be direct connected to Ball & Wood engines.

There will be two exciters, one engine-driven and one motor-driven, both of 25 Kw. capacity.

There will also be one motor-generator set, consisting of 30 H.P. motor and 20 Kw. generator, for operating a traveling crane.

It was at first contemplated to use the exciter current for supplying the cranes, but on account of the distance of the shop from the power house, the extreme variation of load on the crane motors, and the fact that the generators would have to be wound for 250 volt excitation, it was deemed best to make the crane set a separate unit.

The main switchboard will be one of our standard boards, consisting of 8 panels with horizontal edgewise instruments and quick break switches.

The crane motor-generator set will have its own switchboard conveniently located near the set.

The motor equipment will consist of 44 standard Form K motors, ranging from 5 to 50 H.P.

The lighting of the plant will be supplied from step down transformers, located at convenient points.

### MYLES SALT WORKS

**Weeks Island, La.**

A very interesting electrical development has recently been installed for the Myles Salt Works, Week Island, La., consisting of one three-phase, revolving field, belted 200 Kw. generator, and six induction motors, aggregating 125 H.P. capacity.

A 40 H.P. motor is used to drive a salt rock crusher in the mine, 600 feet below the surface. The shaft leading to this mine passes through about 90 feet of earth and quick-sand. It then strikes solid salt rock, and comes through this for about 500 feet. The idea in sinking this shaft so deep was to insure strength to the roof of the mine.

Owing to the bad effects of salt dust and air on the motor it was necessary to enclose it, so to get the proper ventilation, a fan was installed on one end of the shaft. The intake pipe extends to the top of the shaft, and the air is drawn down through it, passing out at the other end of the motor. This arrangement not only answers the purpose of ventilating the motor but also supplies fresh air to the mine.

Three 20 H.P. and one 15 H.P. motors are placed in the large bins, and are used for driving the salt mills, screens, conveyors and car pullers. As they are subject to dust and

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fumes from the salt, in was necessary to enclose them also, a fan being used on each motor to give the proper ventilation. The intake pipe, however, it was only necessary to carry to the outside of the building. There is also a 10 H.P. motor situated outside of the building and used for driving a pump.

This is one of the finest salt mines in the world, the rock coming out perfectly pure, so purifying and filtering is entirely unnecessary. The capacity of this mine is 500 tons per day. The electrical outfit has been running without the slightest hitch since installed, and the officers of the mine are delighted with their equipment.

**ELECTRICALLY EQUIPPED PRINTING PLANT**

The new plant of the Stecher Lithographic Company, Rochester, N. Y., is equipped for general lithographic work of all kinds, and is provided throughout with General Electric Company apparatus, the current being supplied for motors together with arc and incandescent lighting.

The generating plant consists of two 100 Kw., 250 volt, Form L generators, direct connected to Ames engines, provision being made for the subsequent addition of another unit of the same size.

The switchboard is made up of our standard panels of black enamel slate, and comprises two generator panels, one receiving panel, which is arranged to take current either from the generators or from the Rochester Power circuits, one six circuit motor feeder panel, and one six circuit lighting feeder panel.

Both generator and feeder panels are furnished with double-throw switches and with two sets of bus-bars, so that either generator may be operated separately on any number of circuits, or both generators may be run in multiple.

Separate circuits are provided throughout for lighting and motors.

The wiring from the switchboard to the centers of distribution is run on insulators, using General Electric wire and wiring supplies.

The factory is equipped with sixty-five 220 volt single carbon multiple arc lamps, the lamps being furnished with clear inner and outer globes.

The wiring for branch circuits to the motors and to the controllers is rubber-covered and run in loricated conduit tubing.

The motor equipment consists of 62 motors, aggregating 171 H.P. Of these motors, there are 27 standard printing press equipments from 2 to 7½ H.P., all motors being compound wound, variable speed, for 50% variation by field, and are equipped with belt-tightening idlers and R-43 controllers.

The remainder of the motors, 35 in number, operate paper cutters, small presses, and other miscellaneous lithographic machinery throughout the plant, these motors being standard shunt or compound wound motors, with standard automatic starters, the rheostats and switches for these motors all being mounted on slate slabs.

This plant affords an excellent example of a modern printing plant with complete General Electric equipment.

**INDUCTION MOTOR IN CEMENT PLANT**

**Newaygo, Mich.**

The following letters are the outcome of a report which was circulated concerning the operation of the General Electric induction motor installed for the Newaygo Portland Cement Co., Newaygo, Mich. The letters will explain themselves:

CHICAGO, July 21, 1903.

Mr. D. McCOOL, President,
Newaygo Portland Cement Co.,
Newaygo, Mich.

Dear Sir:—

In an interview between two of our representatives and Prof. Carpenter on Saturday last, in connection with negotiations which we have pending with the Mississippi Valley Portland Cement Co. of this city for a plant at Louisiana, Mo., for which company Prof. Carpenter is Consulting Engineer, he made the statement that your plant at Newaygo was a failure and that you had been having all kinds of trouble with your machinery, including the electrical apparatus. This statement was brought out by Mr. Lyman, our Chief Engineer, mentioning your plant as an illustration of the success of induction motors in cement works, Prof. Carpenter having contended that direct current motors were about as good. I am very greatly surprised to learn that you have had any trouble with either your electrical or other machinery

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and was under the impression that your cement plant was one of the most successful in the country. If there is foundation for Prof. Carpenter's statement, I will very much appreciate your giving me the facts confidentially, particularly with reference to any trouble you have had with our apparatus. I cannot but think that Prof. Carpenter is misinformed, for if you had been having trouble you naturally would have fallen back upon us. If, on the other hand, there is no foundation for the statements, I will be very much obliged if you will write me a letter that we can show to Prof. Carpenter to prove to him that he has been imposed upon. Yours truly,

(Sgd.) JAS. W. JOHNSON,
Mgr. Power & Mining Dept., Chgo.

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NEWAYGO, MICH., July 23, 1903.

Mr. JAMES W. JOHNSON, Mgr.,
Power & Mining Dept.,
General Electric Company,
Chicago, Ill.

Dear Sir:—

Replying to your favor of the 21st, would say I note what Prof. Carpenter says about the Newaygo plant being a failure. If he is correct in his opinion, it is quite fortunate that up to the present time we have not become aware of the fact. On the contrary the plant has run without an hour's interruption since we started our first kiln on the morning of June 1st, 1901, up to the present time, except ten days that we shut down last November on account of the impossibility to get coal. So far as the electrical equipment is concerned, I will say it leaves nothing to be desired. It has been emminently satisfactory in every particular. A good many of our motors have not been shut down for an hour since we started two years ago. We have only damaged one motor and that was on account of inexcusable carelessness. The only repair we have made to any of them is re-babbitting some of the bearings of motors that work in extremely dusty locations.

There is, as far as I know, absolutely no foundation for such a report. Very truly yours,

(Sgd.) NEWAYGO PORTLAND CEMENT CO.,
D. M. McCool, Prest.

## CONSTANT CURRENT TRANSFORMERS

### BANGOR, ME.

The city of Bangor has just placed with us order for the fourth 100 light constant current transformer with panel, and also an order for sub-bases to permit any two adjacent transformers out of a total of four, to be operated either single circuit or three-quarter phase connection on the three-wire circuit.

### KENNEBUNK, ME.

The town of Kennebunk, Me., recently lost its light station by fire. Its street lighting consisted of 300 25 C.P. series incandescent lamps operated from step-up transformers and R.D. reactive coil. We have just sold two 17½ Kw. constant current transformers to take care of this incandescent street lighting.

### LACONIA, N. H.

The Laconia Electric Light and Power Company, Laconia, N. H., recently lost its station by fire. The street lights of Laconia were the series direct current type, operated from brush machines. Although the lamps, of course were not damaged by the fire, the Laconia Company decided to have all its lightings of one character, and has placed an order with us for three 250 light, air cooled transformers with 95 lamps.

## MISCELLANEOUS

### FORM H OIL SWITCHES

The Edison Electric Illuminating Co., of Boston, Mass., has just placed with us an order for two triple-pole, single-throw, 2300 volt, 1200 ampere, Form H motor-operated switches; sixteen of the same type, 15,000 volts, 300 amperes; four 15,000 volts, 500 amperes, and six 15,000 volts, 800 amperes. These switches, and a number of others, for which orders are to be placed, will be used in the L Street, Zeigler Street, Dedham, and Natick Stations. In connection with them will be used overload relays and time limit relays of various kinds.

### MASSACHUSETTS ELECTRIC LIGHT ASSOCIATION

The annual outing of the Massachusetts Electric Lighting Association was held at Hotel Pemberton, at Hull, on the 7th day of August, there being sixty central station representatives present. Dinner was presided over by C. L. Edgar, President of the Association. The courtesy extended to the Association by the Boston manager of the General Electric Company was very much appreciated.

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# General Electric Company Review, October, 1903.

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# GENERAL ELECTRIC COMPANY REVIEW

VOL. I SCHENECTADY, N. Y., OCTOBER, 1903 No. 6

GENERAL ELECTRIC COMPANY REVIEW

The REVIEW is published monthly for the information of officers and employees of the General Electric Company only.

MARTIN P. RICE, - - - - - *Editor.*
EDMUND P. WALLER, - - - *Ass't Editor.*
CARYL D. HASKINS, - *Commercial Conferee.*

News items and contributed articles for the issue of any month must reach the Publication Bureau by the twentieth of the preceding month.

Good photographs can be readily reproduced in the REVIEW and frequently add to the value of descriptive articles.

## THE ADVANTAGES OF ELECTRICAL DRIVING OF PRINTING MACHINERY

The application of electric power to the operation of printing machinery has increased very rapidly during the past year. The field for the electrical driving of printing presses is very large. Both large and small printing establishments are now realizing the importance of eliminating the great waste of power required to drive large quantities of heavy shafting, especially during certain hours when all shafting is running and only a small number of machines are in use. By eliminating all overhead shafting and substituting electric motors for each press, the efficiency of the plant is greatly increased.

One of the most important points to be considered in a printing office is the proper distribution of power. Although the electric light is universally acknowledged to be the best illuminant, it is less generally understood that electric power is the most economical, efficient, reliable, flexible, convenient and clean method of operating printing presses. The work of a press is unavoidably intermittent, and the advantage of individual motors for such use is plainly discernible. In this instance, the motor is always ready, consumes power only in proportion to the work it is doing, and requires no power when idle.

With belt drive and shaft distribution the losses are nearly constant, and much power is being consumed whether the work is being done or not. Losses attending transmission of power by shafting vary widely, depending upon the class of work, arrangement of presses, relative direction of shafts and their adjustment, lubrication and alignment. Experience has shown that the substitution of an electric for a mechanical system of driving printing machinery very materially increases the output. This result is due to the remarkably steady speed of the electric motor when built for constant speed, and the exact adjustment of speed, when speed variation is required. In a transmission by belting, each belt slips more or less, and as the power usually passes through several belts, the cumulative loss of power and speed is not only larger but constantly varies with the condition and tension of the belts and power transmitted.

In electric transmission, the speed regulation of each motor is practically that of the engine which supplies it with power and is therefore extremely close.

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There is a limit to the speed at which any machine may be run successfully, and if there is a variation in speed, the maximum speed must never exceed this limit or the press will be damaged and the quality of the product lowered. The greater the variation in speed, the slower the average speed and the smaller the output of the press. The constant speed of the electric motor permits presses driven by it to run constantly at their maximum speed. Where presses run at various speeds, the usual practice is to employ stepped cone pulleys. The speeds obtained in this way are few in number (usually three or four), and, therefore, if a wide range of speed is necessary, the different speeds must be far apart.

If power is furnished by variable speed individual motors with speed controllers having a range sufficient to fill in between the mechanical steps, the press may be driven always at the highest possible speed and maximum production. It is this great variety of speeds that makes it possible to operate the press at the speed best suited to a maximum production of the work in hand and thus show a greatly increased output over mechanically driven presses. This increased production is, in many cases, so great as to fully justify the installation of an individual electric motor system, even if there were no other advantages to be obtained.

Not the least desirable feature of the electrical operation of machinery is the better hygienic condition for the employees. The almost complete freedom of the electric system from shafts, bearings and belts is important as they not only cut off light, but stir up dust and throw oil. Cleanliness is always to be desired, and is essential in printing establishments where it gives an immediate return in a better quality of output.

From data at hand, we believe the average daily output of a plant using individual motors will show an increase of at least 15% over and above a similar plant using a mechanical power application. In addition to the time saved during the make-ready and actual running, there is the practically absolute freedom from breakdowns that tie up the entire plant. Managers of large publishing houses and newspaper offices are beginning to realize the great amount of power which is wasted in driving their large edition presses.

When a variation of speed is required on these presses, this variation is generally brought about by the use of an idler pulley and allowing the tension of this pulley on the belt to change, thereby allowing the belt to slip, thus giving the proper speed at the press.

In the past year a number of individual electric motors for linotype machines have been installed. Forty-five are now operating in Boston. Quite a number of motors have been sold to printing press manufacturers who have shipped their machinery, equipped with electric motors, to all parts of the country. These manufacturers have found that it is very much easier to sell their machines electrically equipped than when built for belting to shafting.

A few of the advantages of operating printing presses by electric motors are as follows:

Economy of power;

Independent operation of individual presses—each press is an independent unit, and can be started or stopped without regard to other presses;

Overtime possible without keeping the whole plant in operation;

Expense proportionate to actual work of press;

Reliability;

Better speed control;

Flexibility of application;

Cleanliness;

Quietness;

Better light;

And no dust or oil dripping from overhead shafting.

The final result of all these desirable features is to enable the progressive printer, who adopts electricity for driving his machinery, to produce more work in a given space—better work—and do it more quickly, thereby reducing cost, and thus make larger profits.

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## INCANDESCENT LAMPS

It is painfully true that incandescent lamps look much the same to many people, and as a matter of fact they may look somewhat alike, but this sameness is entirely in mechanical detail.

Incredible as it may seem, otherwise well informed isolated plant owners will install high grade apparatus in their desire to have a first class lighting plant and utterly disregard quality of incandescent lamps employed, thus impairing the efficiency and satisfactory operation of the whole plant and rendering the lighting poor, when a trifling additional investment of a very few dollars in high grade lamp would produce entirely different results.

It must be admitted that the incandescent lamp is the most important part of a lighting plant. The function of the boiler is to make steam; the engine creates mechanical power; the dynamo generates electricity, but the incandescent lamp fulfills the primary object of the entire plant; that is, produces light, the quality of which is accurately determined by the grade of the lamps used. It is, therefore, self-evident that in order to secure the full benefits and maximum efficiency of a well equipped plant, incandescent lamps of the best quality must be used.

At the same time, it is equally true that the performance of an inferior plant is greatly improved by the use of a good lamp. Such plants however are to-day in the minority. A lighting plant using an inferior lamp is as badly handicapped as one employing a wasteful fireman. Both are sources of most extravagant loss and both are reckless wastefulness dangerously disguised.

In conversation regarding some 16 candle-power lamps that had decreased in candle-power 50%, the manager (or more correctly speaking, the mismanager) of a large isolated plant told the writer he did not care about the candle-power of the lamps in question; they gave, he said, sufficient light. The very few cents saved in the price of this low grade lamp blinded the purchaser to the fallacy of using an unreliable lamp. This instance is by no means an uncommon one. It is not infrequent, when testing, to find so-called low priced lamps reduced in candle-power 40 or 50 per cent. after burning one or two hundred hours. More light could be produced by the same expenditure of energy, or the same light could be obtained in return from a smaller consumption of power, coal or money, as you please.

It would be vastly more economical in this case, or in any other, to use high grade 12 candle-power, 42 watt lamps that would retain 80 per cent. of their candle-power or not drop below 9.6 candles, than to use 56 or 60 watt lamps giving only 8 candle-power. A larger number of useful candle hours can be obtained from a high grade 12, than a low grade 16 candle-power lamp. By so doing, a much better quality of light is secured, and at the same time the highest economy practiced.

The evil existing in this branch of the electric lighting business can be corrected by using goods offered by eminently reliable manufacturers, or by maintaining a lamp testing outfit, consisting of a photometer, wattmeter and voltmeter. The actual candle-power and wattage could be definitely determined, together with a life test, making a record every fifty or one hundred hours to ascertain the maintenance of candle-power. By so doing the purchaser could determine for himself the grade of every lot of lamps received.

Many lamp buyers make a test of several different makes of lamps and place their orders for years based on this one test, which in no way determines the three hundred day average quality of the lamps selected. Whereas, if fifteen or twenty lamps out of each barrel received were tested as described above, consumers could, with comparatively little trouble, settle the quality of lamps for themselves.

A small producer with limited facilities can often furnish a few fairly good lamps, while his yearly product may average very poor.

Considering that most consumers receive their lamp supply in six or twelve installments during the year, it is a three hundred day average which is important and not the

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quality of any one lot of lamps. If purchasers would decide for themselves the grade of every lot shipped them, in a short time only high grade lamps would find a market. The incandescent lamp business would be revolutionized and the fittest would alone survive.

While this condition to a large extent is rapidly shaping itself, it can never provide for the very small consumer, who not using incandescent lamps in sufficient quantity to warrant means for testing, would do well to use the product of a reliable producer and not accept unknown brands of obscure manufacturers, usually expensive, even at a low first cost. If such lamps were not of inferior grade, why should they be sold at reduced price? The maker realizes they are inferior and acknowledges it in the price asked. Lamps, like any other commodity, are not superior because sold at the price of a good article, but improved methods in manufacturing have brought the best lamp down to a point where it is not economy to sacrifice quality in consideration of first cost or risk getting poor lamps by accepting goods of amateur manufacture. A lamp without a reputable sponsor, or one sold at reduced price is usually cheaply made and many of the most important tests omitted that enter into the manufacture of a first class lamp.

The peculiar conditions entering into the manufacture of incandescent lamps enable larger producers to furnish the best goods, and it is noticeable that only small and unknown producers offer their production at reduced prices, the grade of which will invariably average low. If intelligent discrimination was exercised by small consumers and a little painstaking precaution by the larger users, only incandescent lamps of pronounced merit would be offered for sale, thereby employing the inventive genius now at work by scores of small and unreliable lamp producers in improving methods of producing high grade lamps rather than originating ingenious and almost unscrupulous methods to dispose of worthless goods.

### SPLIT-PHASE PATENTS

It will be remembered that the Westinghouse Company succeeded in having its Tesla patents Nos. 511,559 and 511,560, which are the broad patents on split-phase motors, and which cover induction meters, sustained both by the Circuit Court and by the Court of Appeals in Ohio in the suit against the Dayton Fan & Motor Company, and that the same patents were sustained and held to cover a meter by the Circuit Court in the so-called "Catskill Suit" in New York, but that the Court of Appeals in New York decided that the patents were invalid because in that suit no sufficient proof was made of the date of Tesla's invention as compared with the date of invention of Galileo Ferraris. More complete proofs of Tesla's date of invention were put in by the Westinghouse Company in a suit pending against the H. C. Roberts Electric Supply Company, of Philadelphia, to which suit the Sangamo Company, manufacturers of the Gutmann wattmeter, subsequently became a party, and a decision has just been handed down by the Circuit Court sitting at Philadelphia in this suit, holding that in view of the proofs made it is clear that Tesla was the first inventor and that the patents are valid and cover the Gutmann wattmeter. We are informed that the Westinghouse Company intends to prosecute litigation on these patents actively against all infringers.

Copies of this decision have been sent to all local offices.

The General Electric meters are licensed under the Tesla patents.

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# TRANSMISSION

### A 110 MILE TRANSMISSION LINE

The Washington Water Power Company, Spokane, are just about ready to start the commercial operation of their one hundred-mile long-distance transmission plant, which is the longest distance transmission in the Northwest. There have been installed two 2250 Kw., 4000 volt, General Electric, revolving field generators, each direct connected to a Victor Turbine, operating under a head of seventy feet. The switchboards are installed on a gallery overlooking the whole power house, all main bus bars being installed in separate pottery compartments underneath the gallery. Two sets of bars allow the city service and the transmission system to be separated when necessary. All generator switches are General Electric, Form H, motor operated, remote control. These switches operate with such rapidity upon closing the relay switch upon switchboard that no difficulty is encountered in synchronizing machines. The exciter is direct connected to separate water-wheel without governor. A Lombard governor is installed to operate each of the larger generators; only one of these governors, however, will be used at a time, as a practically constant gate opening on one wheel will be used, allowing the governor on another wheel to regulate for the whole station.

Three water-cooled General Electric transformers (with one spare for emergencies) step the voltage up from 4000 to either 45,000 or 60,000 volts, depending upon connections, for the long distance transmission. There are no high tension switches other than disconnecting switches installed between line and transformer primaries. General Electric lightning arresters are installed, each S.P. arrester being in separate brick compartment extending from lower floor of building to high tension wires which are near the roof.

The line is approximately 110 miles long to the furthest power user; a portion of the line runs through marshy or boggy country where considerable trouble was experienced last winter with ice forming around the pole butt and finally lifting the pole out of the hole; this difficulty was overcome by putting horizontal cross pieces on the butts underground. The line consists of three No. 2 solid copper wires, with 60,000 volt Locke Insulators and iron pins. These pins are made of about three-inch wrought iron with cast iron shanks, for insertion in cross arm, and lead threads.

There are six sub-stations, each equipped with three-phase, step-down, water cooled, G.E. transformers, varying in size from 100 Kw. to 750 Kw., with primary taps for 60,000 or 40,000 volts, according to line pressure; each sub-station is equipped with an automatic high tension oil switch connected between transformer primary and line, these oil switches being mounted in separate brick compartments above the panel.

The power will be used almost exclusively for mining purposes, the most notable installation being at the Standard and Hecla Mines, where four General Electric, 300 H.P., induction motors will be used to drive compressors, hoists, etc. One of these motors, Type M, will be geared direct to a hoist. There is an aggregate installation of about 800 H.P. in synchronous motors and the balance in induction motors. The General Electric synchronous motors will be started direct from line through low voltage taps on transformers.

The plant has already been operated for some time with no load at end of line, and although 60,000 volts has been the line voltage, no defects have been encountered. The plant will probably operate commercially within a month.

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# POWER APPLICATIONS

## ELECTRICALLY OPERATED BOX CAR LOADER

The Victor Box Car Loader manufactured by the Link Belt Machinery Company of Chicago is used for loading coal, ore and similar material in box or stock cars.

The machine is under direct control of the operator upon the platform. Its action is so expeditious that cars of 30 tons capacity have been loaded in six minutes while a loader is capable of handling 2500 to 3000 tons in a day of ten hours.

The General Electric Company has furnished a number of equipments for these loaders, one of which is in operation at the Walsen mine of the Colorado Fuel and Iron Company at Walsenburg, Colo. The work of the loader averages from 650 to 850 tons per day of ten hours, but the actual operation probably does not extend over one-fifth of this time.

The electrical equipment consists of a GE-800, 500 volt, compound wound motor with controller.

Regarding flexibility and superiority of the electric drive over steam, this can readily be determined from the fact that the frame is moved back and forth, making it necessary to use flexible connections to the driving apparatus, and the possibility of running cables to a motor is by far superior to any hose arrangement to steam or air driven apparatus. These loaders are generally placed in a small building close to side track, and when one car is loaded, by properly manipulating the levers the complete machine is withdrawn from the car and another car is moved forward, and the loader projected into the side doors of the car itself; all of this being done without the operator leaving his place in the loader.

The Local Mine Superintendent states regarding the capacity and satisfaction of this machine, that for expedition in loading cars and the quantity of coal handled, there is no comparison whatever with manual labor. Although they handled from 650 to 850 tons per day, there is no reason why the loader should not handle two or three times this amount, providing that the output of their mine could be increased accordingly.

## KIMBERLY-MONTANA GOLD MINING COMPANY

**Jardine, Montana**

We recently closed a contract with the above company for an electrical equipment for operating their mines near Jardine, Montana; the power house equipment consisting of:—

One 350 Kw., 4400 volt, revolving field, 60 cycle, water-wheel driven generator, with exciter and switchboard.

The generator is direct coupled to an Abner Doble Company's water-wheel, operating under an effective head of 770 feet. The water is taken out of the Bear Creek tributary of the Yellowstone River, and is conveyed through an open ditch and flume a distance of 9920 feet, thence 3120 feet through a steel pipe line to the power house. From this point the power is transmitted electrically a distance of three and one-half miles to the sub-station centrally located at the mines and containing:—

Three 125 Kw., oil cooled transformers together with transformer and feeder panels, at which point the voltage is stepped down to 460 volts and distributed to two 75 HP., 440 volt, Form K induction motors, for operating two stamp mills, the motors being belt connected to line shafts.

One 100 H.P., 440 volt, Form K induction motor, belted to compressor.

One 10 H.P., 440 volt, Form K induction motor, for operating tools in machine shop.

The speed and voltage of the generator is somewhat lower than we would ordinarily recommend for the head and distance, but as we happened to have the generator available for prompt shipment it was decided to purchase same, although a generator of higher speed and voltage was offered as promptly as ours by one of our competitors, and for less money. Their decision was influenced by the good results being obtained from our apparatus operated by the Annie Laurie Mining Company, Kimberly, Utah, Mr. Kimberly being interested in both companies.

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### MOTOR DRIVEN FIRE PUMPS

The Chicago Edison Company purchased from us and installed in the basement of Marshall Field & Company's wholesale house, Chicago, a waterproof motor for fire protection, which has attracted considerable attention. The equipment consists of a General Electric, CE, 100 H.P., 230 volt, shunt wound, totally enclosed motor, with a fan mounted on the armature shaft, inside of the frame, between the armature and pinion end bearing. The purpose of this fan is to ventilate the windings by drawing air through a large wrought iron pipe, screwed into a flange fastened onto the front end of motor frame. The air passes through the motor and is discharged out of a similar opening at the opposite end, thus keeping the field coils and armature at a safe temperature when operating at full load. The electrical conductors to the motor are led in through a pipe screwed into the frame, and in fact the construction is such, that a fire stream of water can be played upon the motor or it can be completely submerged in water without injury. The motor is geared, through a single reduction, to a Laidlaw-Dunn-Gordon 8½ x 12 duplex, 60 R.P.M. pump, connected to a sprinkler system with which the entire building is equipped. The pressure of the system is maintained at 100 lbs. per square inch, by means of a pressure gauge so constructed that when the pressure goes below 100 lbs. the needle or hand of the gauge closes an electrical circuit through an automatic controller, thus starting the motor. When the pressure increases to the desired amount the gauge hand closes another circuit through the controller and stops the motor. The motor controller being also waterproof, the basement in which the apparatus is located may become filled with water without shutting down the pump, an advantage which is obvious. The installation is a complete success and customer contemplates duplicating the outfit at an early date and discarding another steam pump.

We also sold an outfit to the Underwriters' Bureau of Fire Protection Engineers, consisting of a CE, 50 H.P., 220 volt, totally enclosed and ventilated motor, direct connected to a No. 7 Quimby screw pump which has a capacity of 500 gallons per minute at 100 lbs. pressure. The motor receives current from an Edison three-wire system and is controlled with an R-15-D rheostatic controller constructed so that the motor can be started on 110 volts and when up to about half speed is thrown on 220 volts by the reverse cylinder, the shunt field being connected permanently on 220 volts. This gives 12 different speeds as follows, which is a great advantage for testing purposes:—

| 110 Volts | 220 Volts |
|---|---|
| Step 1, just turning over | 470 R.P.M. |
| " 2, 119 R.P.M. | 585 " |
| " 3, 230 " | 695 " |
| " 4, 330 " | 795 " |
| " 5, 400 " | 865 " |
| " 6, 435 " | 900 " |

The motor is compound wound with the series winding connected accumulative. The resistance (dimensions 20" x 20" x 26") used for starting is immersed in running water and takes up very little space in comparison to air cooled resistance. This outfit is installed at the Underwriters' Laboratory at 67 East 21st Street, Chicago, and is used for testing hose, hose nozzles, sprinkler heads, valves and all apparatus used for fire protection. The Underwriters' Engineers state that the motor has given universal satisfaction and they will be pleased to exhibit it in operation to visitors at any time.

### ROYAL CONSOLIDATED MINES

**Hodson, Cal.**

The 120-stamp mill connected with these mines was started on July 21st, and embraces some new and interesting features in milling practice. It is the largest mill in California, and is capable of crushing an enormous quantity of ore daily. It is run entirely by electricity, receiving current from two sources, the Stanislaus Milling & Power Co. and the Utica Mining Co.

The rock breaker has a three-phase, 150 H.P., Form K motor, belted to a line shaft. This shaft operates a Blake No. 7½

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crusher, capable of crushing 125 tons per hour through 2½″ screen. It is then taken by a conveyor having a capacity of 250 tons per hour to two No. 4 Blake crushers, each having a capacity of 20 tons per hour, crushing through a ¾″ screen.

The mill is operated by six three-phase, 50 H.P., Form K motors, each motor driving 20 stamps or four batteries. The motor is belted to a short counter-shaft, and this in turn is belted on either side of the four batteries, so that any battery can be cut off if desired. The stamps weigh approximately 1050 pounds and make 106 drops per minute. It was estimated that the capacity of the mill would be eight tons to the stamp in 24 hours, but this has been exceeded, as they have crushed 10½ tons since starting. There are two 30 H.P. motors on either side of the mill, taking care of the concentrators, each side being equipped with 12 Standard concentrators, which take the first wash of the pulp, and six Johnson concentrators, which take it after it leaves the Standards.

The ore is conveyed from the shaft to the mill by an electric tram 1640 feet in length and equipped with one LM-105 locomotive on a 24″ gauge track. Current for the locomotive is furnished by a motor-generator set, consisting of a 30 H.P., Form K motor, direct connected to D C. generator. The ore cars carry four tons of ore apiece, while the locomotive will haul four or five of these cars on each trip.

Besides the motors mentioned above, there are one 40 H.P., one 20 H.P., one 10 H.P. and one 5 H.P. motor, driving machine shops and supplying other power about the mines.

The transformer plant consists of three 250 Kw., 60 cycle, air blast transformers, and three 100 Kw., 60 cycle, Type H, oil cooled transformers, 15,000 volts primary, 575 volts secondary. In connection with them there are blower sets, consisting of 8-H.P. motors direct connected to Buffalo blowers.

It is estimated that it would cost less than 90 cents a ton to mine and mill this ore, which consists of a very large vein of low grade rock. The vein proper is about five feet wide, but the country rock is gold bearing for a width of 25 feet, all of which will be milled, and which will average $3.00 per ton in value.

### COAL HOIST

The coal hoist installed at the power station of the Boston Elevated Co., has a capacity of 50 tons per hour, the bucket weighs 2100 pounds and lifts 2300 pounds of coal per trip. The hoisting speed is 300 feet per minute. The hoisting drums are geared to a 60 H.P. General Electric motor which runs at 550 revolutions per minute. The controlling mechanism is an R-21 controller operated by a ¼ H.P. direct current motor.

There is also a coal hoist installed at the wharf of the Edison Electric Illuminating Co., Boston, Mass., having a capacity of 200 tons per hour. The weight of the bucket is 2200 pounds and it lifts 2500 pounds of coal per trip at a hoisting speed of 900 feet per minute. These hoisting drums are direct connected to two 100 H.P., 250 volt motors operated at 120 revolutions per minute. Type M control with C-7 controller is used. For the travel two 40 H.P. motors with K controllers are used.

### PRINTING PRESS MOTOR EQUIPMENTS

We have recently completed an installation for the Springfield Printing and Binding Co., Springfield, Mass., in their new, six story, brick building, of the following printing press motor equipments:

One 85 Kw., 115 volt, direct current, belted generator.

One switchboard.

Twelve cylinder press motors — using belt tightener heads, R-43 controllers, push button circuits on presses for stopping press.

All wiring enclosed in iron conduit.

Motors have enclosing covers.

Terminals of motors are enclosed with a special covering, wiring conduits entering this terminal cover.

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Besides the above motors, one 5 H.P., one 7½ H.P., one 10 H.P., all slow speed, CE motors have been installed on ceiling, for running the special groups combining machines, embossing presses, job presses, and paper cutters.

The following advantages are quite noticeable in changing from mechanical to electrical drive: absence of noise and vibration, better light, less dust, no dripping of oil, absolutely constant speed, greater production with better results, entire absence of shafting in cylinder press rooms, and the fact that presses have now ten points speed instead of three or four, as by the old mechanical means.

## UNITED FRUIT COMPANY INSTALLS UNLOADING PLANT

### Electrical Invention of Messrs. Harris and Eddleston Will Take 15,000 Bunches of Bananas from a Ship in One Hour — Taunton Emptied of Fruit in a Jiffy

A labor-saving device that is expected to revolutionize the method of unloading bananas from the vessels of the United Fruit Company was officially tried and found highly satisfactory at the Illinois Central fruit wharf yesterday morning. The steamship Taunton, from Port Limon, tied up yesterday morning at 10 o'clock and was unloaded by the new process. The invention was accepted by the fruit company and will hereafter be used in connection with the unloading of the company's vessels.

By means of the new method the bananas can be unloaded in one-half the time previously required by hand labor, and the perishable fruit will be hurried to the Northern and Eastern points without so much delay.

With 7,000,000 bunches of the fruit to be unloaded during the year, the method will work great benefit, not only in unloading, but in allowing the boats of the company to clear in quicker time. The new method will also prevent damage to the fruit, and where tried has saved two-thirds of the fruit ordinarily wasted.

The new machine for unloading the fruit was built by the Link Belting Company, and is operated by Constructors William Riley and Eugene Kell. It was invented and first patented in 1897 by George J. Eddelston, construction engineer of the Alder-Weinberger Steamship Company, and Beverly J. Harris. The invention was improved and placed in its present shape in 1902. The machine is run by electricity, by a motor connected with the main current of the city, and is shaped somewhat like the carrier of a threshing machine, such as is used in the wheat belt of the Northwest. It is built upon a platform upheld by ten trucks. From the platform steel booms rise each in the shape of a hinge which opens and shuts. As the steamship is moored to the wharf and the hatches are opened the hinge opens and is lowered into the hold. Then the carrier runs up perpendicularly some forty feet and across to the wharf. In the center of the platform on the wharf the wheels are stationed for moving on a rail track laid for that purpose. A lookout tower is stationed on top containing four levers for the entire control of the machine, which may be operated by one man. The levers start or stop the machine by friction gear, move it along the wharf when necessary, and hoist the main boom over the deck of the vessel.

The canvas carrier which revolves around pivots placed at each end of the steel boom is divided by bars of wood into pockets thirty inches in length and forty-eight inches in width. As the canvas drops into the hold it is loaded by means of the pockets at each deck and swiftly carries the fruit up the perpendicular boom and across to the wharf.

Under the old method many negroes were stationed in the hold at one hatch at a time, and lifted fruit from deck to deck, and thence over the side of the vessel. The fruit was considerably bruised and the stems broken by the process. The highest rate of speed attained by the method was about twenty per minute, or 1200 per hour.

Under the new process, however, not so many men are needed in the hold, the fruit is not bruised in the least, the stems are not broken and a minimum of 15,000 bunches per hour may be unloaded. Yesterday, with but one hatch open, and one machine in operation, forty bunches per minute or 2400 per hour were unloaded. With three hatches open and three machines working together, with better facilities for carrying the fruit to the wagons and cars, a rate of eighty per minute on each carrier may be attained, with a total of nearly 15,000 bunches unloaded per hour.

Mr. Eddelston said yesterday that the method had been tried for the past year in Mobile, and 500 vessels had been unloaded by it. During that time it had not been necessary to make $10 worth of repairs. He said that the juice of the fruit seemed to strengthen the canvas instead of rotting it. Superintendent Ellis of the United Fruit Company, who inspected and accepted the new device, said yesterday that more men would be required on the wharf, but not so many on the vessel. He said that the benefit of the new method would accrue from the saving of time and from the saving of damage to the fruit. He said that several members of the Dock Commission had been at the wharf during the morning and were enthusiastic over the operation of the machine.

The track will soon be extended along the entire distance of the wharf, two other machines of the same kind will be added, and it will then be possible to adjust all three to one vessel or three vessels along the wharf.—*New Orleans Times-Democrat, June 28, 1903.*

The above installation is equipped with standard General Electric Induction motors.

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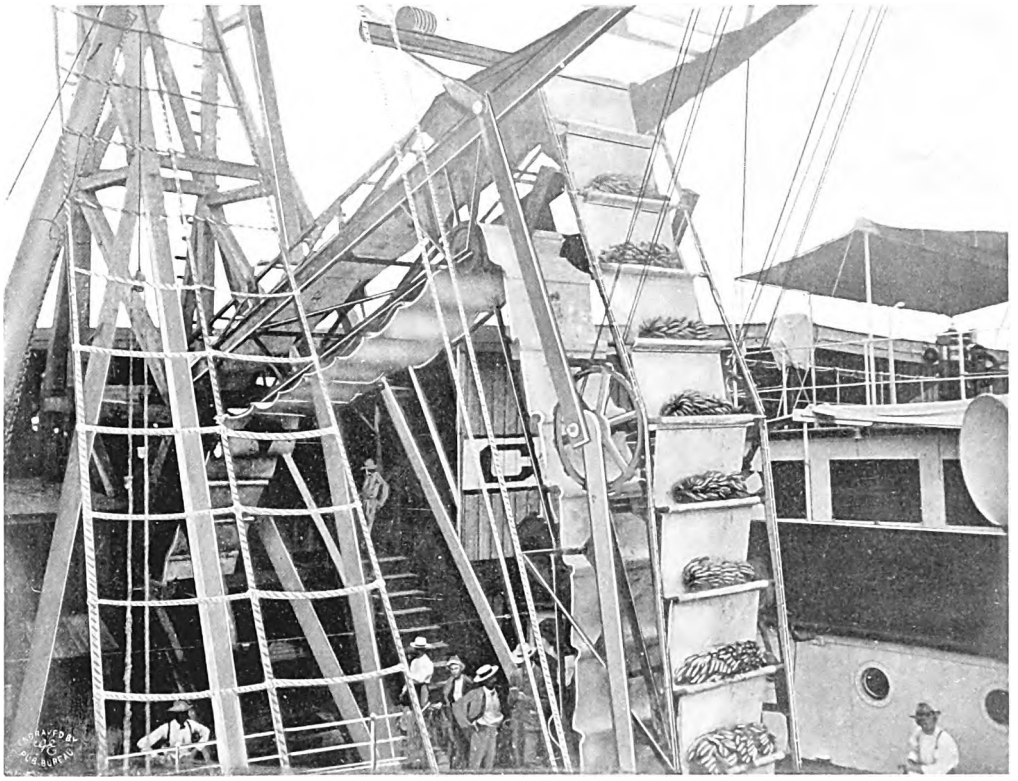
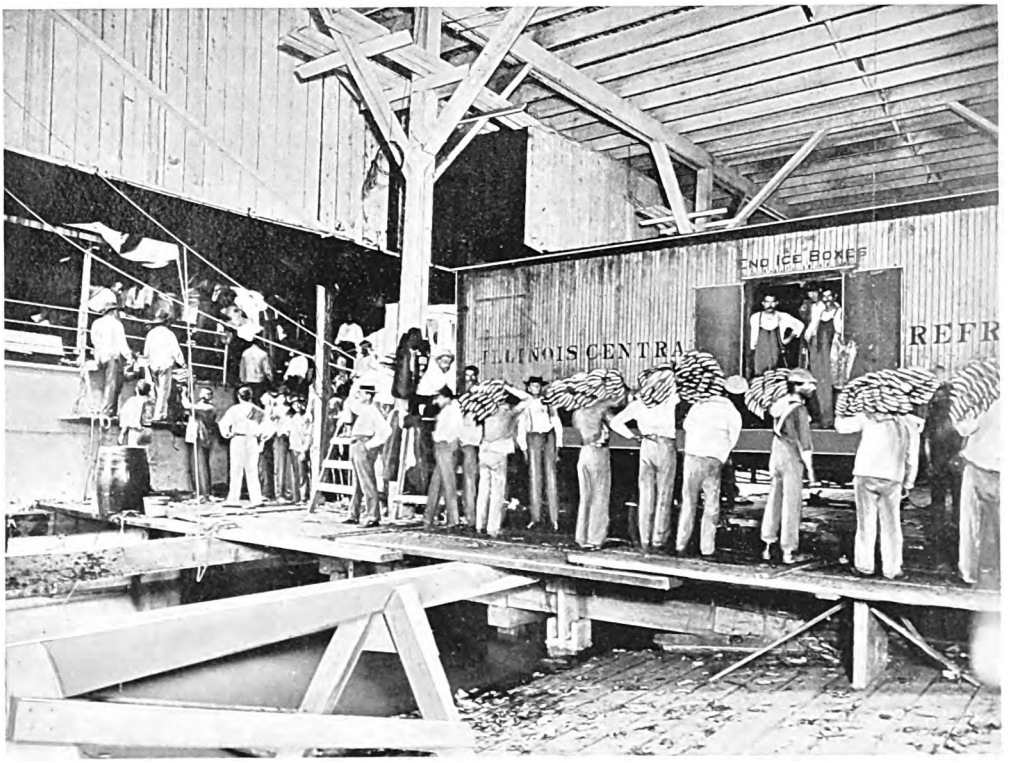


View of Machine Unloading Bananas from Vessel




Old Method of Unloading Bananas from Vessel

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**Machine for Unloading Bananas from Vessel**

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# LIGHTING

### SERIES INCANDESCENT LIGHTING

Series incandescent lighting from alternating circuits, in the past, has been accomplished in various ways, and about the first system for this purpose was known as the "Bank Board," from which a series of lamps, the number depending upon the voltage of the circuit, were operated at either 3.5 or 5.5 amperes.

In some sections of the country, what is known as the "Shunt Box" system, was quite extensively used.

The CR type of regulator was considered an improvement, as it covered a wider range of regulation.

The next step in advance was the reactive coil, from which an automatic regulation was obtained over a range of from 25% to 100% regulation; but, where 100% regulation was obtained, under most conditions the size of the regulating device would be quite large and expensive. While the reactive coil, differing from the types above mentioned, was automatic in its action, it did not quite answer the full requirements, on account of its being compensating connected to the primary circuits, and, thereby, increasing the liability of grounds on the generators, transformers and other appliances connected with the circuit.

Installation of Series Incandescent Lighting

For some time the General Electric Company has recommended for arc lighting the "Constant Current Transformer System." With this system the secondaries of the transformers are entirely separate and distinct from the primary, so that a ground on the street lighting circuit affects only the circuit on which the ground exists. The transformers can now be supplied in several capacities and wound for varying conditions.

Very successful results are being obtained in and around Philadelphia from prob-

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ably the smallest type of transformer for commercial use, viz : 4.4 Kw. capacity, wound for 1.12 amperes. On a basis of 3½ watt lamps, this transformer would have a capacity of, approximately, seventy 16 candle-power lamps, or thirty-five 32 candle-power.

One of the first installations of this kind was made by the Beacon Light Company of Chester, Pa., where they now have nine transformers, eight of which are operated regularly, and one reserved for emergency use. At this point the constant current transformer system displaced five hundred shunt boxes.

Results were so satisfactory at Chester that the Wilmington City Electric Company, fifteen miles distant, purchased eight transformers of like capacity and winding for their requirements, displacing about four hundred shunt boxes.

The Cheltenham Electric Light, Heat and Power Co., of Oak Lane, a suburb of Philadelphia, have five of the transformers in successful operation, and the Jenkintown Light Co., supplying light in an adjoining section, have three.

The Lebanon Electric Co. placed an order a few days ago for two, making a total of twenty-seven transformers of this size, aggregating a total of 1890 lights capacity, on a 16 candle-power basis.

This system is considered very efficient, as it enables the use of the standard sixteen and thirty-two candle-power lamps, when selected for series burning.

Although constant current transformers for series incandescent lighting in other capacities are used extensively in this section, we believe the greatest satisfaction has been expressed by our customers with the system generally outlined above.

### THOMASTON ELECTRIC LIGHT & POWER COMPANY

**Thomaston, Conn.**

We have received order from the above company for addition to their central station equipment, the new apparatus to consist of one 100 Kw., direct connected, three-phase generator, with belted exciter, to be operated as a single-phase machine at 75 Kw.; one complete marble switchboard for same, consisting of generator and feeder panels, and one 35 light, constant current, air cooled, transformer with complement of lamps.

### NEW YORK CITY FIRE DEPARTMENT

**New York, N. Y.**

We have obtained order through contractor for one 10 Kw., marine type generating set and one 18″ standard projector with extra diverging lens, for use on the new fire boat now building.

This is the fourth order we have received from the city for similar equipments.

### LEAVENWORTH LIGHT & HEATING COMPANY

**Leavenworth, Kansas.**

The above company have obtained contract for supplying the government post at Fort Leavenworth with current, and have placed order with us for additional equipment, consisting of one 500 Kw., three-phase, standard, 2300 volt, revolving field generator with three 200 Kw., step-up transformers for the transmission line, at 6600 volts, and three similar step-down transformers. They have also purchased one 50 light, air cooled transformer with complement of lamps.

### BUFFALO, ROCHESTER & PITTBURG RAILROAD COMPANY

**Buffalo, N. Y.**

The above parties have placed order with us for four 30 Kw., marine type generating sets, for use at their various shops.

### INVERTED ROTARY CONVERTER

**Edison Electric Illuminating Co., Lebanon, Pa.**

To effect a saving in the operation of the arc light system which was operated by four 50 light, T.-H. arc generators, and the Edison 3 wire system, during the light load period, the above company have installed in their plant a 100 Kw, inverted, rotary converter, together with four 50 light, air cooled, constant

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current transformers and a 100 Kw., motor driven alternator, which enables them to supply series alternating current arc light in the outlying districts at Lebanon.

The 100 Kw. rotary converter takes the current from their railway generator and operates three 50 light, constant current transformers to supply the street lighting. The economy of this arrangement is due to the fact that two engines and four arc generators are dispensed with, while at the same time it improves the load factor of the railway unit.

In addition to the 325 Kw. railway generator already installed, the above company has placed orders with us for the following apparatus:

One 100 Kw., inverted rotary converter, 500 volts D. C. side, 310 volts A. C. side, with panel for A. C. and D. C. sides of the converter.

Four 50 light, 60 cycle, air cooled, C. C. transformers, 6.6 amp., primary voltage 310 volts.

One hundred and sixty series alternating enclosed lamps with reflectors.

Three 50 light, C. C. transformer panels, 310 volts.

Two 4.4 Kw., 310 volts, 60 cycle, 1.12 amp., C. C. transformers for street incandescent lighting.

One 100 Kw., motor driven alternator, 500 volts, D. C. side 2300 volts, 60 cycle, three-phase, A. C. side with generator panel and Type A regulator.

One 125 H.P., 500 volt motor.

### LIGHTING A DEPARTMENT STORE

**Manufacturers Outlet Company, Providence, R. I.**

With strong competition, we secured an order from the above company for 160 five ampere, direct current, power circuit lamps. These lamps are somewhat special, as the resistances are mounted outside of the lamps in the ceiling canopies. The lamps have been very satisfactory, and a second order for 120 has recently been placed.

### KEENE GAS LIGHT COMPANY

**Keene, N. H.**

The present plant is located on a water privilege three miles from Keene, and consists of two 150 Kw., 2300 volt generators, with exciters, switchboard and TA regulators, one for each machine. The present water power is not sufficient to carry over the peak of the load, and an auxiliary steam plant is necessary, which has to be used a part of each day.

To avoid the necessity of using a steam engine, this company have developed another water privilege one mile above their present station. In this way they will eliminate the steam plant.

They have ordered from the General Electric Company one 150 Kw., 2300 volt generator, with switchboard, exciter and TA regulator, for this new station. The contract also covered an incoming and total output panel to be installed in the old station, arranged so that the two plants may be synchronized at either switchboard.

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# CONSTANT CURRENT TRANSFORMERS

### CONSTANT CURRENT TRANSFORMERS OPERATED ON A DIRECT CURRENT SYSTEM

An interesting example of the application of constant current transformers for direct current central station plants, suggests the further extension of this idea to mill lighting plants. The Edison Electric Illuminating Company, Sunbury, Pa., originally supplied the street lighting from two No. 8, Wood arc machines, wound for $9\frac{6}{10}$ amps.

This company desired to enlarge their plant by adding an alternating current generator to take care of the lighting in the outlying districts too remote for the operation of the direct current system. They also desired to substitute for the open arc system, the enclosed arc lamps. At the suggestion of the General Electric Company, they installed a 60 cycle, two-phase, inverted rotary converter, which operated from the 230 volt, direct current bus-bars and delivered 60 cycle, two-phase alternating current at 163 volts which operated two 50 light, constant current transformers.

This arrangement greatly simplified the operation of their system and improved the economy of the plant. For supplying incandescent lamps to the outlying districts of the town, two transformers were furnished for raising the 163 volts A.C. current to 2300 volts. The transformers were provided with dial switches, so that the line voltage could be varied 10% in steps of 1%, thus allowing the transformers to compensate for the line drop and variations in the direct current bus bars pressure. This company placed an order with the General Electric Company for:

One Q.C, 100 Kw., 60 cycle, quarter-phase rotary converter, D C. end 230 volts, A.C. end 163 volts.

Two 50 light, 6.6 amp., 60 cycle, oil cooled, C.C. transformers, primary wound for 163 volts.

One hundred Form 3 lamps and reflectors.

One mechanical and electrical speed limiting device and panels for D.C. and A.C. sides of the converter.

One panel for the two C.C. transformers.

One 40 Kw., Type H transformer.

After this installation it was found that, under a 50% load and 50% power factor, with the load concentrated on one phase of the rotary converter, the speed of this machine increased only 12%, which increase had no apparent effect on the operation of the system.

### PLYMOUTH LIGHT & POWER COMPANY

**Weymouth, Mass.**

This company has just placed with us an order for two 50 light, air-cooled, constant current transformers, to be operated directly from a 3120 volt, three-phase, General Electric generator. This is the second sale of constant current transformers for this plant. Those already in use include two 50 light and three 35 light transformers.

### MUNICIPAL PLANT

**Holyoke, Mass.**

We have recently received order from Holyoke for two additional 50 light, air-cooled transformers and 100 arc lamps. This material in addition to the original contract for 400 lights capacity.

### NORTHAMPTON ELECTRIC LIGHTING COMPANY

This company has recently ordered three 50 light, air-cooled, constant current transformers and 130 arc lamps which will be used in fulfilling the new city contract.

### MUNICIPAL LIGHTING PLANT

**Taunton, Mass.**

This plant has just placed an order with us for nine 50 light, 2200 volt, 60 cycle, air-cooled transformers, and 275 arc lamps. Incandescent lamps will be operated on the same circuits.

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# RAILWAY

## SOME REMARKABLE TRANSPORTATION FIGURES

Of peculiar interest and importance is the first quarterly report of the Interborough Rapid Transit Company, showing the results of the operation of the elevated railways by electricity as compared with steam. The three months covered began on April 1, about the time when complaints of the insufficient transit accommodations were at their height. The new system of propulsion had just been completed, and a good part of the additional cars that had been ordered had been delivered. For all practical purposes, therefore, it may be considered that this quarter, though not the heaviest in the point of traffic of the year, affords a fair basis for judging the advantages of electric propulsion.

That the public had gained very materially in convenience and speed of transportation has been apparent for many weeks. How great the gain to the company has been the figures which we published yesterday plainly attest Net earnings from passenger traffic for the three months increased by no less than $513,554 over those of the corresponding quarter in 1902, and by $557,000 over those of 1901, a saving in operating expenses of almost $100,000 having been effected by the change of power. Still more remarkable is the fact that this very marked economy attended a great increase in the number of passengers carried. In the previous year the accommodations offered by the cars drawn by locomotives were insufficient for the demands made upon them, and the Manhattan Company was apparently unable with steam traction to extend its facilities. Electricity proved to be not only much cheaper than steam but far more effective. The increased regularity which it permitted in the service made possible the operation of a greater number of trains, and the decrease of vibration and the added power rendered it easy to enlarge the trains during rush hours. As a result more passengers were carried and fewer straps were used, the increase in the former having been 8,406,183 in the quarter, or about 100,000 a day, omitting Sundays. These figures show that while it cost the Manhattan Company 2.42 cents to haul each of 57,699,258 passengers by steam during April, May, and June, 1902, the Interborough Company, using electricity, carried 66,105,436 during the same months this year for 1.98 cents each, a saving of very nearly half a cent a passenger.

In the light of this showing one cannot but marvel at the tardiness of the Manhattan Company in adopting an improvement which meant so much to its own exchequer as well as to the comfort of its patrons. At the same time it illumines the recent message from the State Railroad Commission congratulating the public on the relief to the congested traffic afforded as a result of the commission's intelligent efforts.

To the subway company the figures are certain to prove highly interesting. If passengers can be carried overhead for 1.98 cents apiece, it is probable that they can be carried on a solid roadbed underground for still less. And if traffic is increasing at the rate of 100,000 passengers a day over last year under the stimulus of such improvements as have been possible on the elevated roads there need be no fear that business will be lacking for the subway system.

There is a lesson in these figures also for the railway companies which carry the residents of our suburbs to and from the city, a lesson which none of them has been quick to learn. That it will eventually be learned by all railway companies and so applied that electric power will supersede steam locomotives altogether is no longer an extravagant conception. The great problem before our transportation companies to-day is how to keep down operating expenses so as to get some advantage from increasing gross earnings. The first quarterly statement of the Interborough Company points clearly to the direction from which the solution must come.

## INTERBOROUGH REPORT

### Manhattan Elevated Road's Better Showing Under New Management

The quarterly report of the Interborough Rapid Transit Company, embracing the figures for the operation of the Manhattan Elevated Railway lines since April 1, when the subway company took them over under lease, was made public to-day. It shows increases in earnings and decreases in operating expenses since the new management took hold, as well as increases in the number of passengers carried.

The gross earnings of the company, all from the operations of the elevated lines, were $3,271,787, an increase of $414,537 over the gross earnings of the corresponding period of 1902, under the old management. The expenses were $1,302,089, a decrease of $99,217.

The three months' net earnings amounted to $1,969,698, an increase of $513,554. The item of other income is $90,187, a decrease of $21,100, the figures for the total income being $2,059,885, an increase of $492,454. Interest and taxes were $684,563, an increase of 28,714, making the three months' surplus $1,375,322, an increase of $463,740.

The operating expenses, expressed proportionally, were 39.80 per cent, a decrease of 9.23 per cent. The passengers carried numbered 66,105,436, against 57,699,248 in the corresponding period of 1902, an increase of 8,406,188.

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The report for the year, including the Manhattan and the Interborough figures, shows $12,208,337 gross receipts, an increase of $1,542,426, and 246,587,022 passengers carried, against 215,259,345 carried in the previous year, an increase of 31,327,677 passengers.

The operating expenses were 44.73 per cent., against 51.74 per cent. the year before, a decrease of 7.01 per cent.

### NORTH SHORE RAILROAD

**San Francisco, Cal.**

The North Shore Railroad, San Francisco, Cal., which was officially opened August 19th, is noteworthy in two important particulars. It was formerly a steam road but is now being operated electrically, using a third rail. This is the only third-rail road in the state of California. The section at present in operation lies between Mill Valley and Sausalito, Cal., and is about seven miles in length. Power is furnished by the Bay Counties Power Company and delivered to the Alto power station at 40,000 volts, where it passes through suitable step-down transformers and rotary converters and is fed to the third rail at 550 volts direct current. An auxiliary steam plant using oil fuel is located in the Alto power house, also a storage battery of sufficient capacity to carry the load for half an hour. The Alto power house is situated about seven miles from Sausalito, Marin County, Cal.

The rolling stock of this road was furnished by the St. Louis Car Company and consists of motor cars and trail cars. Five of the motor cars are provided with double-motor, GE-57 equipments with K-11 controllers and twelve with double-motor, GE-66 equipments with Type M control. The trail cars are provided with third-rail shoes capable of handling 500 amperes at a speed of 50 miles per hour. The motor cars carry both passengers and baggage, and the trail cars passengers only. Each car has a seating capacity of 66.

Trains of five cars have two motor cars, one at each end, and three trailers. Such a train is capable of carrying 300 people. The seven miles of road is covered in about nine minutes. The operation of this road has so far been perfectly satisfactory and a regular passenger schedule has been established.

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# PERSONALS

### GENERAL SUPERINTENDENT

**Appointed for the Schenectady Works**

The following letter has been issued by Mr. G. E. Emmons, General Manager of the Schenectady Works:

September 9th, 1903.

The growth of the Schenectady Works, having necessitated an increase in its Executive force, the office of General Superintendent has been created.

Mr. E. B. Raymond is hereby appointed General Superintendent with the following Assistant Superintendents: H. Farquhar, W. T. Clark, J. F. Madgett.

In the absence of the Manager, the General Superintendent will be the ranking officer in charge of the Works.

Foremen will report to and be governed by instructions from the General Superintendent's office in matters pertaining to electrical and mechanical testing and inspection of apparatus and materials, corrections of defects that develop in manufacture, suggested changes in methods or design of apparatus, operation of machine tools, readjustment of facilities and help, as requirements may arise, shop discipline and other matters relating to the economical operation or general condition of departments.

The scope and duties of the Mechanical Superintendent, Electrical Superintendent and Production Manager will continue as at present.

The above will take effect Monday, September 14th, 1903.

(Signed) G. E. EMMONS,
Manager.

Mr. Raymond, upon graduation at the Massachusetts Institute of Technology, entered the works of the Thomson-Houston Electric Co. at Lynn, Mass. He was connected with the Railway Dept. for some time, and then entered the Calculating Dept., where he remained until the consolidation of the Thomson-Houston and the Edison General Electric Co. He was then transferred to the Chicago Office, where his attention was given to installations and the location of outside trouble.

In March, 1895, Mr. Raymond was transferred to the Schenectady Works and made the Foreman of the Testing Dept., which at that time employed 85 men. Under his direction it has been enlarged to meet the increasing demand until there are now 580 men employed.

The splendid system of testing now in force, by which each machine is operated under actual running conditions, is due largely to Mr. Raymond's enterprise and thorough knowledge of the subject. These qualifications with Mr. Raymond's natural executive ability, should make him very valuable in his new field.

Mr. E. F. Collins, who has for several years been Mr. Raymond's assistant in the Testing Dept., will assume the duties of the foreman of that department.

### ENGINEER OF THE LOCAL COMPANIES

Mr. Theodore Stebbins, who for several years has been connected with the company in the capacity of Engineer of the Local Companies, has severed his connections with the company and is located in Boston, Mass., where he is engaged in consulting engineering.

Mr. F. L. Dame has assumed the duties of Engineer of the Local Companies.

Mr. Dame graduated at the Massachusetts Institute of Technology in 1889, and was connected with the Westinghouse Company for a short while as District Engineer for Oregon, Washington, Idaho and British Columbia. He was then connected with the Vancouver Railway and Light Co., until he resigned to accept a position with the Northwest Thomson-Houston Co., where he remained until some time after the consolidation of that company with the Edison General Electric Co. In 1894, Mr. Dame was transferred to the Tacoma Railway and Power Co., where he represented the General Electric Co., and later with the Union Electric Co., Dubois, Iowa, in the same capacity. On August 19th, 1903, Mr. Dame was transferred from Dubois to Schenectady and assumed the duties of Engineer of the Local Companies.

Mr. Dame's wide experience in outside work will make him especially valuable in his new field of labor.

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# MISCELLANEOUS

### OIL SWITCHES

**Edison Electric Illuminating Company, Boston, Mass.**

We have been negotiating with this company in regard to a large number of Form H-3, motor operated switches of various capacities and of different voltages up to 15,000 volts, and a quantity of Form K-4, automatic oil switches. These switches, together with the necessary overload relays, current transformers, etc., are to be used in the different sub-stations of the Edison Company. Orders have been placed for 28 switches, all of the Form H, motor operated type.

### HIGH VOLTAGE TESTING SET

The General Electric Co. will supply to the American Steel & Wire Co., Worcester, a high voltage testing set for testing marine cables up to 100,000 volts. This set will consist of a 90 Kw., 25 cycle, single-phase, 500 R.P.M. generator and two 45 Kw. transformers, each one having a range of from 1000 to 50,000 volts. The two transformers can be used separately on different work or can be connected together for 100,000 volts when desired. The generator will be direct connected to a 124 H.P., 6 pole, 220 volt, direct current motor, which will operate from their main generating plant. This new testing set will supplant the 50,000 volt set of our make which they have been using for several years.

The above company are constantly adding to their motor plant, which now aggregates several hundred horse-power. They have recently ordered from us two 50 H.P. and two 90 H.P., slow speed, 220 volt, C.L. type motors, which will operate their wire rope mill. The machinery in this mill is now driven through compact line shafting. Many of the machines are quite complicated and very long, requiring driving at a number of points. On this account it was found advisable to split up the main shaft and continue the drive as at present.

### GENERATORS FOR WIRELESS TELEGRAPHY

The General Electric Company has recently developed and built a high frequency generator specially designed for wireless telegraphy or laboratory work requiring a very high frequency current.

The machine is rated as an AS 320-2-3750, which gives a frequency of 10,000 cycles per second at 100 volts. The generator is belt driven, and is unique in the fact that it gives a frequency of 10,000 cycles per second.

These machines have been furnished to Prof. Elihu Thomson, Lynn, Mass.; Massachusetts Institute of Technology, Boston, Mass., and Prof. R. A. Fessenden, Old Point Comfort, Va.

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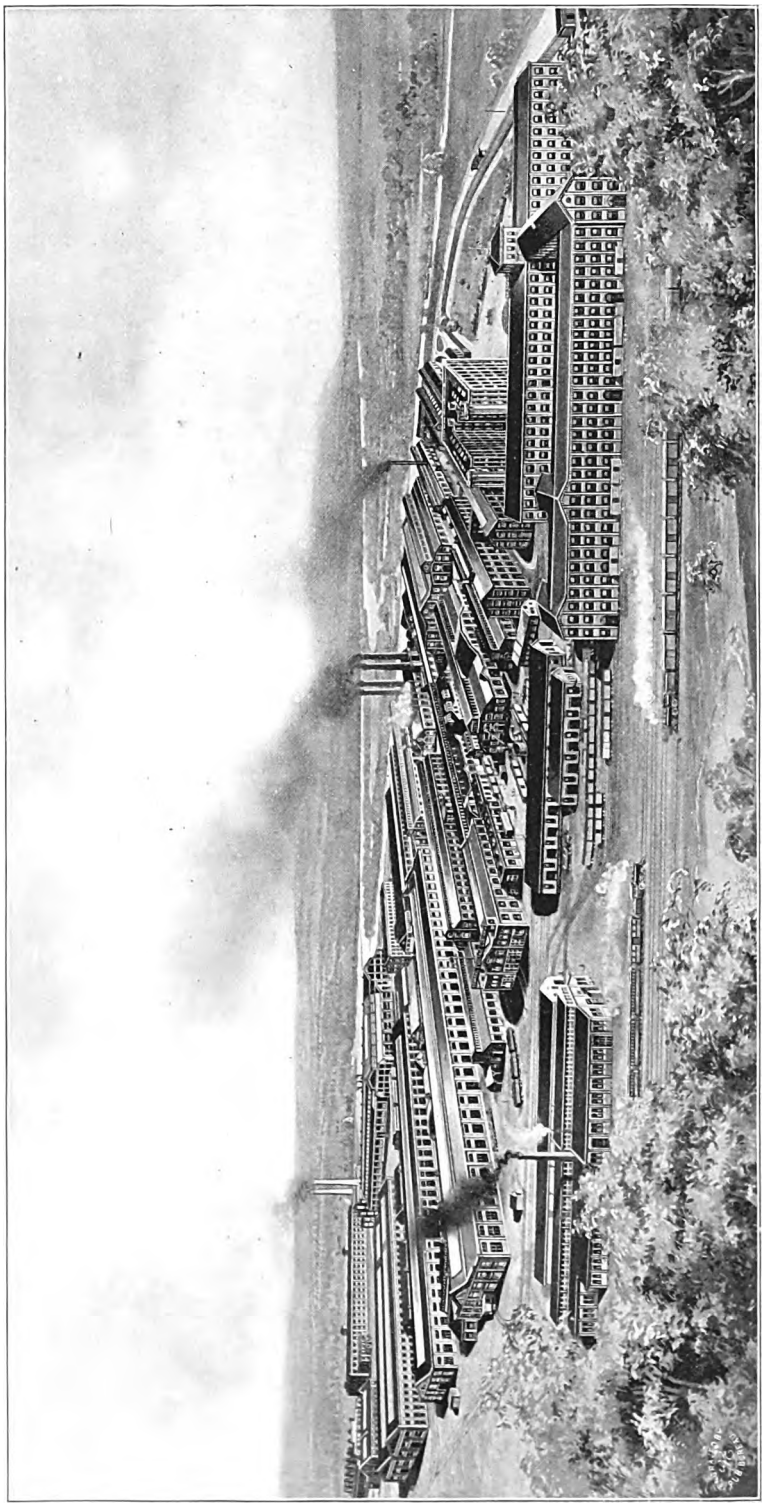

View of Schenectady Works

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